THE FORMATION OF FAVOURABLE ENVIRONMENTS FOR URBAN EXPERIMENTATION: CONTEXTUAL DYNAMICS AND TRANSFORMATIVE CAPACITIES IN BRISTOL AND MEDELLÍN

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I hereby declare that this thesis has not been and will not be submitted in whole or in part to another University for the award of any other degree.

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SUMMARY:

This is a study of the contexts in which urban experimentation flourishes. I aim to understand how favourable environments for experimentation form and how they may be mobilised to generate the capacities that underpin urban transformations. Experiments - practice-based, learning-oriented, and challenge-led initiatives and projects - feature prominently in contemporary attempts to rekindle urban governance to address climate change and foster sustainability. Despite current research interest, how certain cities sustain vibrant experimentation and whether that generates transformative capacities remain underexplored.

Research on urban experimentation is blooming within the field of sustainability transitions. However, there is little clarity about how place and context matter. The uneven geographies of experimentation are under-conceptualised. Most empirical research traces specific experiments or sequences of experiments associated with a given technology. Hence, there is a neglect of the multiplicity of experimental processes embedded in a particular urban context. To address these issues, I draw, critique and expand on strategic niche management and the geography of transitions, to argue for an alternative analytical strategy and conceptualisation of urban experimentation.

The thesis begins with an extended background chapter engaging with conceptual debates on the role of urban experimentation in urban transformations, followed by three interlocking research articles. The first presents a place-based approach and a case study of the environment for civic energy experimentation in Bristol (UK). The second scrutinises studies on the contexts for urban experimentation, deriving three lenses that facilitate context-sensitive studies to pluralise the debate on how to foment experimentation. The third examines the contextual dynamics influencing the mobility experiments and development of transformative capacities in Medellín (Colombia).

My research contributes to understanding how experiments and context co-evolve, highlighting the recurring dynamics which allow the generation and retention of urban transformative capacity. It enables stakeholders to reflect on how to mobilise experimentation to further urban transformations.

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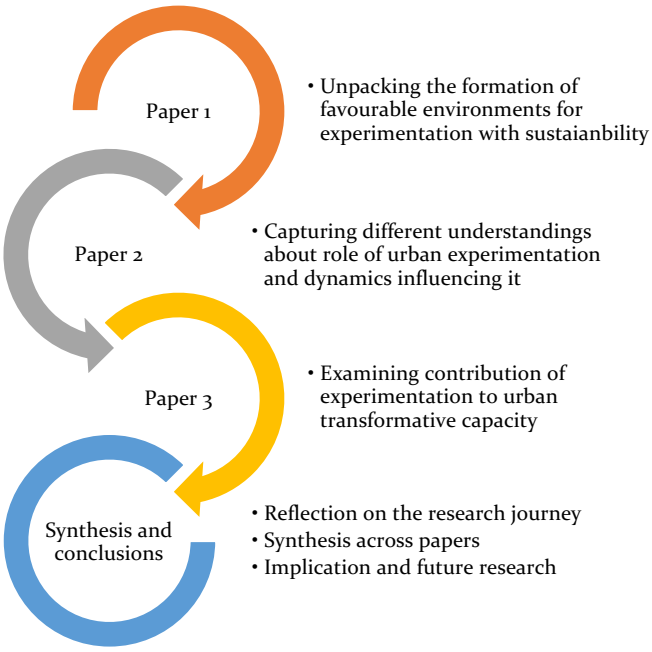

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LIST OF ABBREVIATIONS

AMVA: *Area Metropolitana del Valle de Aburrá* (Metropolitan Authority of the Aburrá Valley)

BCC: Bristol City Council

BEN: Bristol Energy Network

BFOE: Bristol Friends of the Earth

BGCP: Bristol Green Capital Partnership

CAT: Centre for Alternative Technology

CSE: Centre for Sustainable Energy (Formerly UCAT)

DIY: Do-it-yourself

EDU: *Empresa de Desarollo Urbano* (Urban Development Company);

ELENA: European Local Energy Assistance, a grant from the European Investment Bank

EMU: Energy Management Unit, a team within the Bristol City Council

EPM: *Empresas Publicas de Medellín* (Medellín's Public Utility company)

ICLEI: International Council for Local Environmental Initiatives

IPCC: Intergovernmental Panel on Climate Change

LA21: Local Agenda 21

Metro: Metro de Medellín Ltda

MLP: Multi-level Perspective

PRIMED: *Programa Integral de Mejoramiento de Barrios Subnormales en Medellín* (Integral Program for Subnormal District Improvement in Medellín)

PUIs: *Projectos Urbanos Integrales* (Integrated Urban Projects)

SNM: Strategic Niche Management

SPRU: Science Policy Research Unit

STRN: Sustainability Transitions Research Network

UCAT: Urban Centre for Alternative Technology

UN: United Nations

UTC: Urban Transformative Capacity

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PREFACE

I fell in love with them on the road. The cities, I mean. One after the other, they shook what I took for granted, shaped my routines, and enriched my tastes, in life and in work.

Curitiba, Lyon, Paris, Madrid, Nantes, Stockholm, Brighton and now Utrecht. And Bristol and Medellín, for shorter periods. The cities through which I lived my meandering academic life. On the way, I noticed that each was inventing new ways of being a city. I saw them changing to cope with the changes that are coming. I found hope in their will to adapt and transform and thrive.

I grew up in Curitiba (Brazil) in the 1990s, as a regular rider of the celebrated Bus Rapid Transit system. I saw the city change with acupunctural urbanism, transport-oriented development, and a variety of other urban innovations with widespread acclaim. The city's international profile as a leader in sustainability contrasted with the lived experience of its citizens, particularly the poorest. Witnessing a city of 'best practices' struggling to transform itself made me curious about the city/innovation/sustainability juncture.

After moving to Lyon (France), which pioneered modern bike-sharing and bike-centric riverside regeneration, I became an avid cyclist. When living in the outskirts of Paris, I had to resort to commuting but rediscovered walking. In Madrid, I lived nearby another riverside regeneration, which hid away the road to make space for people. Later still, I had the chance to live in two European Green Capitals (Stockholm and Nantes), noting the eco-districts which had sprung to replace abandoned harbours and industries. Moving to a drafty house in Brighton (UK), at the height of austerity, was a reminder of how uneven those processes were, given the disparities in (financial) autonomy and governance capacities. It also made evident how vibrant grassroots groups could fight creatively to fill the voids of a retreating local state. Now in Utrecht, I discovered what a cycling culture is really like but miss aspects of those other cultures.

Each of those cities was facing supposedly shared challenges (e.g. climate change mitigation and adaptation, air pollution, post-industrial decline), but in their own ways, filtered through their place-specific concerns and distinctive political and administrative cultures. What is innovative in one city is banal in another (e.g. insulated houses in Brighton and Stockholm), what is routine in one is unthinkable in another (e.g. cycling in Lyon and Utrecht and in the outskirts of Curitiba, Paris or in Madrid). And even among that small sample, concepts and narratives are visibly circulating, being discovered and rediscovered.

Each of those cities shaped my sense of place in the world and sparked my motivation to undertake this research. I want to express my gratitude by writing about the processes which may help them learn, adapt and transform.

1 INTRODUCTION

If the UK government were determined to fund a laboratory for civic energy alternatives and community-led sustainability initiatives, Bristol would be a strong contender. And if the Colombian government or the Inter-American Development bank were to invest in a laboratory for innovating in mass-transit and social inclusion, few experts would question the wisdom of choosing Medellín. Both cities came to concentrate experimentation and innovation with a specific character, sustained over long periods, and in the process developed distinct competencies. Similarly, Berlin, Bogotá, Copenhagen, Curitiba, Freiburg, Portland, Stockholm, Singapore, Seoul, and so many others have at some point became synonymous with urban innovation. It is easy to take for granted that certain cities seem more experimental and innovative. Yet, as this thesis will argue, questioning how such a status is achieved is central to present efforts to foster urban sustainability transitions.

And if delegations from Bristol and Medellín and those other cities were to meet at a conference, their mayors would sit in panels and discuss how they use such well-funded laboratories to tackle their sustainability challenges. At the party, and during the coffee breaks, however, their sustainability officers would likely share tales of a long history of less flashy, more uncontrolled, diffuse and fortuitous 'experiments', community initiatives, projects, and the people and culture that made them possible and held on to the experiences. It is with that story that we engage here.

Cities around the world – i.e. their mayors, government officials, local universities, civil society and local firms - are having to face multiple sustainability challenges, searching for ways to navigate the fast pace of cotemporaneous change. They are increasingly reliant on different forms of urban experimentation to address and navigate multiple sustainability challenges (Bulkeley and Castán Broto, 2013; Evans et al., 2016; Karvonen and van Heur, 2014). Nevertheless, much of the scholarly literature has overemphasised the importance of designated spaces for experimentations such as laboratories or assumed that experimental settings are

primarily formed through controlled protection of boundary conditions, thus displacing more organic and diffuse forms of experimentation. Why experimentation flourishes in particular places and how it is sustained has been largely neglected.

In this document, I address the emerging debates about urban experimentation associated with urban sustainability transitions. My main contribution is to help transition scholars study *how particular places or cities come to develop favourable environments that sustain experimentation and to understand how these environments can be mobilised to develop the capacities necessary for transformations towards sustainability.*

A universal 'model' would be an inadequate response to the diversity of place-specific and historically contingent ways in which such environments develop. This thesis will make inroads towards a more pluralistic approach and analytical strategy, that acknowledges the multiple forms of urban experimentation happening organically (i.e. outside laboratories), and that explores their contribution to the development of transformative capacity. These contributions are primarily aimed at the scholarship on urban experimentation and urban sustainability transitions but are also potentially relevant to practitioners and activists engaged in fomenting urban experimentation with sustainability, and policymakers concerned with mobilising innovation emerging in cities.

Empirically, I adopted an abductive research strategy (Section 2, p. 55) that stresses the interplay between search and discovery, aimed at allowing for the research to follow the leads of empirical work, and to friction exiting theoretical notions with observations (Dubois and Gadde, 2002, 2014). As the opening suggests, I conducted case studies in Bristol and Medellín, two cities that emerged in recent years as exemplars in experimentation and transformations. They proved to be fertile grounds for exploring my questions in ways that led me to reformulate them.

In the following section, I paint in broad strokes the background motivating this research, locating its subject matter and its contribution. We begin with an overview of the multitude of changes to the Earth's environment has been pressing

societies to articulate transformational aims, which cannot be achieved without attention to the urban sphere. We will then discuss the sustainability transitions community, from which I derive much of my understanding of systemic change, highlighting the critiques about the politics of such processes and about its geographical assumptions. Then, we examine the specificities of urban sustainability transitions. Last but not least, I consider the *uses*, *logics* and *loci* of urban experimentation associated with the potential for systemic change in cities. This background will help to delineate a conceptual 'holding-space' for three papers that follow.

In the first paper, I develop an approach to analyse the long-term development of a favourable environment for experimentation and illustrate its application in Bristol. In the second, I unpick the dynamics involved in the formation of such environments, through a review and synthesis of the literature. At last, I explore the links between experimentation and urban transformative capacity, with a case study in Medellín.

Out of these explorations, sustained urban experimentation and the environments that support it re-emerge as a fruitful domain for urban sustainability transitions research and practice.

1.1 Background and motivation

1.1.1 Setting the scene: the Anthropocene?

In our rapidly urbanising and warming planet, societies are increasingly aware and fearful of a combination of persistent and rapidly unfolding socio-technological-environmental issues. Fostering sustainability and resilience in contemporary and future cities is a paramount effort and a remarkable challenge, which will require not just new technologies, but system change; not only incremental but transformative change.

Notwithstanding decades of efforts to embed notions of sustainability, the aggregate impact of human activities has continued to increase and accelerate. The

scale, scope and speed of environmental change, especially since the second world war, have been staggering. That period is now frequently referred to as the 'great acceleration' (Steffen et al., 2015a). Despite moderate successes in efforts to mitigate change, these show no signs of reversal in most such trends (UNEP, 2012). The ensuing alterations to the functioning and structure of the Earth System are so profound that Earth System science community been debating whether the planet has entered a new geological epoch: the Anthropocene (Crutzen, 2002; Crutzen and Steffen, 2003; Crutzen and Stoermer, 2000; Steffen et al., 2005, 2011).

The findings of Earth System Science are hard to digest. Humanity's aggregate impacts are so extensive, pervasive and intensifying so quickly that it may be on the verge of overstepping critical thresholds or tipping points or 'planetary boundaries' and triggering non-linear, irreversible changes that could undermine the conditions that sustain modern human societies (Rockström et al., 2009a, 2009b; Steffen et al., 2015b). Runaway climate change could tip Earth into a 'hothouse' state (Steffen et al., 2018). Biologists further compounded the Anthropocene argument, observing that a 'sixth mass extinction' may be underway (Barnosky et al., 2011; Ceballos et al., 2015). In their interconnectedness, virtually every socio-ecological domain is undergoing similar seismic shifts.

In its boldness and bluntness, the notion of the Anthropocene has provoked thinking about the profundity, ubiquitousness and staggering pace of socio-technological-ecological change. Its geological status and dating remain hotly debated (Hamilton, 2015; Lewis and Maslin, 2015). So are alternative framings of the contemporary socio-ecological condition have been proposed to explore the political dimensions and reassertion on anthropocentrism, which this concept evokes (e.g. Haraway, 2015). For its proponents, the Anthropocene is a call for responsibility to face an existential threat that is uncertain, complex, and urgent. For its critics, it embodies 'rhetorics of singular agency, uncompromising leadership, non-negotiability, certainty and control' (Stirling, 2014). Thus, this notion can illuminate or obfuscate, as it lends itself to storylines of a joint history of humanity and thus potentially divert attention from the diversity and disparity in the human condition (Parnell et al., 2018).

At an ironically slow pace, (most) national governments around the world are beginning to heed to this discourse and the decades of earth system science that preceded it. In doing so, they have committed to targets and goals that would require a wholesale transformation of contemporary society and transitions in multiple systems. In the United Nations Agenda 2030, all countries agreed on the Sustainable Development Goals, laying out a set of 'comprehensive, far-reaching and people-centred set of universal and transformative Goals' (UN, 2015 article 2), embedded in a 'supremely ambitious and transformational vision' for how to achieve sustainable development (UN, 2015 article 7)

On the climate change front, three decades of climate diplomacy culminated in the Paris Agreement, which entered in force on 4 November 2016, with an agreement to limit global warming to 'well below 2°C above pre-industrial levels and pursuing efforts to limit this temperature increase to 1.5°C above pre-industrial levels) (UN and United Nations, 2015). As the follow-up report of the Intergovernmental Panel on Climate Change (IPCC) notes, mitigation pathways compatible with the 1.5°C target:

> …would require rapid and far-reaching transitions in energy, land, urban and infrastructure (including transport and buildings), and industrial systems (high confidence). These systems transitions are unprecedented in terms of scale, but not necessarily in terms of speed, and imply deep emissions reductions in all sectors, a wide portfolio of mitigation options and a significant upscaling of investments in those options (medium confidence)
>
> (IPCC, 2018, p. 17)

Whether and how such rapid, far-reaching and cross-sectoral nexus of transitions can be stimulated, supported or steered by policymakers are open questions. A debate about 'transformative innovation policy' is emerging among scholars and policymakers concerned with aligning the rationale of innovation policy with these challenges (Kuhlmann, 2018; Schot and Steinmueller, 2018; Steward, 2012; Weber and Rohracher, 2012). This emerging framing breaks with uncritical and unwavering support to entrepreneurship and economic growth as a means to

achieve wellbeing, reckoning that decades of support to green technologies and eco-innovation have done little to stave of ecological disaster.

Similarly, there have also been prominent calls for boldly reorienting research and innovation programmes around challenge-led and mission-oriented policies (Mazzucato, 2015a, 2015b). This argument builds on work challenging assumptions about private actors' contribution to innovation and reinstating the proactive role and legitimacy of the state in guiding and steering change (Mazzucato and Penna, 2016). Such policy discourses have been gathering momentum among policymakers, that are still flabbergasted by the challenge of delivering on Paris and the SDGs while keeping atop other pressing agendas.

Despite the transformative framing of these efforts, most still assume that innovation policy is made nationally (or transnationally, at the European Union level), but discount the prevalence of radical innovations happening at other scales and spheres, outside the purview of national governments and innovation agencies. In these discussions, the involvement and endowment of cities and regions are neglected. As the next section will show, that is an untenable position.

1.2 An urban age, an urban planet

This changing planet is increasingly an urban planet; this age, an urban age. Urbanisation is central in the unfolding environmental history of the great acceleration, and its most obvious outcome (c.f. McNeill and Engelke, 2016). Not surprisingly, images of the planet's cities illuminated by night (see Figure 1.1) are a recurring symbol of this epoch, capturing the depth and staggering scale of the planet's transformation; '(…) they epitomize the Anthropocene: the disassembly and reassembly of natural resources, habitats and energy all go into the making of the age of humans' (Waters, 2014). A turning point happened in 2015, when the world counted with more urban than rural dwellers, a number that should not be taken face-value. To illustrate the contradictory and ambivalent role of cities in the contemporary nexus of socio-ecological-technological change, it is worth

considering whether cities, taken as a collective, are engines or stages, victims or beneficiaries, culprits or saviours in this era.

Figure 1.1 Imagery of the 'urban planet' in the Anthropocene. (a) Cover of the International Geosphere Biosphere Programme Magazine (IGBP, 2012) (b) Cover of the Geological Society Special Publication 395 (Waters, 2014) (c) Cover of Science Magazine ("Urban Planet," 2016) *(d) Comic produced by the German Advisory Council on Global change* (WBGU, 2016)

Urbanisation is broadly accepted as an *engine* driving and accelerating Earth System Change (McNeill and Engelke, 2016), and is one of the key signals used to track the great acceleration (Steffen et al., 2007, 2015a). Urban infrastructures, build environment, and the routines which they shape underpin production and consumption behaviours. Since ancient times, building and sustaining densely populated urban areas has been shaping how humans transform their environment, but the staggering pace and ubiquitousness of urbanisation in the past century means that it is now a dominant factor. Since the 1950s, the global *urban* population increased dramatically from around 729 million to 4.2 billion (UNDESA, 2018). Among the most developed countries, and increasingly in middle-countries, over 80% of the population lives in urban areas. Meanwhile, due to migration and reduced fertility, the global rural population grew much more slowly, particularly since the turn of the century. This dramatic shift has multiple environmental consequences, as living in cities is associated with more consumptive and energy intensive life-styles. As a result, it is already the case that 'urban agglomerations are dominant in terms of production, consumption, and associated energy use (irrespective of where these take place physically)' (Grubler et al., 2012). Urban areas account for between 67-76% of global energy use and between 71 and 76% of CO_2 emissions from energy use (Seto et al., 2014). Yet, of the area projected to be urban by 2030, 60% is yet to be built. Urbanisation is not only accelerating but changing patterns, shaping the prospects and evolution of a multitude of both proximate and distant socio-ecological systems (Seto et al., 2010). But if urban development is presently an engine accelerating GLOBAL ENVIRONMENTAL CHANGE, it may well be down-geared, or even reversed, or taken in other directions.

The urban may also be understood as a stage in which the Anthropocene is being performed. Most people will experience of Anthropocene as urban dwellers, so the urban fabric, its infrastructures or the lack-thereof, mediates - dampening or heightening - their vulnerability and agency vis-à-vis socio-technical-environmental change. Living in cities shapes human-environmental relationships, e.g. by reinforcing the conception of nature as a separate and wild or

proximate and familiar. Tellingly, contemporary notions of futures are increasingly represented - literarily, cinematically and scholarly – as noir urbanism dystopias that subvert the dreams of modernism (Graham, 2016; Prakash, 2010). In reverse, when fiction imagines Earth as no longer habitable, utopia takes place in cities in space or in the underground. But if the urban is a stage in which Anthropocene futures are prefigured, there may well be other stories to enact, and alternative voices to recount our time.

Urban areas are also *victims of* global environmental change, with specific profile of risks and vulnerabilities (The World Bank, 2010). From the news coverage of extreme events such as Sandy and Katrina, to the string of daily news about sea-level rise, heat waves, air pollution, and so forth, stories of urban crises are ubiquitous. Local authorities around the world are scrambling to develop resilience to face a suite of new challenges (e.g. increased incidence of extreme events, sea level rising) which may compound and exacerbate already-existing socio-spatial inequalities. Through networks such as the Rockefeller Foundation 100 Resilient Cities, they are experimenting and planning what it means to be resilient. If the cities are victims, they may well not be passive ones, and find their agency, and bounce back.

As *beneficiaries*, a select group of cities have been disproportionally reaping the benefits of the trends which compose the great acceleration. 'A new geography of centres and margins' is well underway (Sassen, 2000), with global cities receiving ever increasing proportions of investment, jobs, and political attention, amassing immense concentrations of power and benefiting disproportionally from knowledge economy, at the expense of low-income and less connected metropolitan areas. Urban areas comprise 60% of the Global Gross Domestic Product (GDP), and in general are wealthier, more (formally) educated. But the 100 richest cities megacities are expected to account for 35% of the global growth by 2025 (McKinsey Global Institute et al., 2011). Eco-modern, green-growth narratives aimed at these behemoths abound among international organisations, recasting the challenges ahead as opportunities for massive investment (Oecd, 2010; OECD, 2013). In this position, cities find themselves surrounded by

technological-offerings which promise transformations. Judging by the techno-optimist media coverage, cities are on the brink of becoming smart, eco, liveable, serviced by automated vehicles and sharing economies, with on-time drone delivery, and underground tunnels to eliminate traffic. In this context, mayors and local elites are steeped into a growing 'market for solutions' (McCann, 2013), as managers of valuable portfolios of innovations and award-winning planning strategies, which could prop up the attractiveness of their cities, to investments and investors, to creatives and (highly productive) bohemians (Florida, 2005). Left unchecked, 'an uneven landscape of "teacher" and "learner" cities' may further the divide between the centres and the margins (McCann, 2013). But if cities are indeed beneficiaries, there may be better ways for sharing those spoils, nearby and abroad.

The urban may also be a *culprit* in these changes, as a polity, a life style and an identity. Urban politics is not inherently progressive, reflexive or innovative. It may have the allure of a closer government, a neighbourly democracy, but it is often riddled with contradictions and petty interests (Campbell, 1996; Castán Broto, 2015; Vogel, 2015). Plans to increase cycling go along with expanding and repaving avenues. For every green belt, an uncontained sprawl; for every energy efficient public building, an ill insulated housing block. Trendy urban life styles may aspire to cycling and recycling, conscious eating and urban farming, but they are often embroiled in (hyper)commuting and conspicuous consumption, take-always and cheap supermarkets. And urban identities may be painted as inclusive, multicultural and avid for change, but there are ever present darker tones, contours of internal exclusion, disparaged populations, and change aversion. Nevertheless, if cities are culprits, they may well repent and reform, learn from past mistakes and find new ways to transcend some of their contradictions.

Cities, and their (ex)mayors, are also increasingly positioned as *saviours,* with the capacities and will to step up where national governments fail. Prominent global change scholars have argued for a 'a global system of cities' could become a central element in a coordinated polycentric governance approach aimed at 'planetary stewardship', for actively shaping the trajectory of change at a planetary level (Seitzinger et al., 2012). In the realm of climate diplomacy, local governments are

proactively organising in multiple trans-municipal networks of global reach, often articulating more ambitious and far reaching visions for a low carbon future than their host national governments. In the aftermath of the Rio 1992 Conference, various such networks sprung up, advocating for the 'local' to be heard in the 'global' environmental conferences. For instance, the International Council for Local Environmental Initiatives (ICLEI), established in partnership with the United Nations Environmental Programme and International Union of Local Authorities as the 'international environmental agency for local governments' (ICLEI, 1996), was central to the Local Agenda 21 that induced many local governments to sustainability. That network has grown to include over 1500 cities, towns and regions, is said to impact over 25% of the world's population (ICLEI, 2018). In contrast, a new breed of networks - such as C40 Cities and 100 Resilient Cities, of which both Bristol and Medellín are members - adopt a more assertive and pioneering stance. Their memberships are highly selective, encompassing primarily metropolis and megacities; members can engage in programmes funded by large philanthropic donations (Bloomberg and Rockefeller foundations, respectively) and various private and public backers. Rather than part of the global effort, led by UN organisations, these networks portray cities as potential leaders. As C40's website boasts unapologetically and repeatedly cities 'get the job done', 'have the power to change the world', 'are the solution' (C40, 2018).

Multiple city governments have taken on the task of stimulating innovation, in increasingly entrepreneurial forms of governance, and aggressive marketing operations to communicate their greenness. Cities, as Grubler et al. (2012) summarise:

> (…) are also unique centres of human capital, ingenuity and innovation, financial resources, and local decision-making processes, which are all 'human' resources that can be harnessed for a sustainability transition. While global and national policy frameworks are clearly needed, ultimately all implementation is place-based and requires local formal and informal supportive frameworks. To promote more sustainable development, cities may thus be the right scale for an 'intermediate' (even mediating) actor level between the individual and national and transnational initiatives. The urban scale is also the appropriate one to identify and realize many options in promoting energy efficiency that may not always be apparent at higher levels of policymaking (…) Cities thus could become *the* innovation centres in developing and implementing solutions in the sustainability transition (…)
>
> (Grubler et al., 2012, p. 1315)

As a result, cities are also asserting themselves in the emergence of a polycentric system for the governance of climate change. Grassroots movements have also been contributing to rethink the role of cities in these negotiations, voicing radical perspectives of how to achieve steep reductions in greenhouse gas emissions and proactively organising innovations that find widespread purchase, from the hyperlocal attempts to stave of unsustainable practices to global networks of activists and transition towns.

It is easy to be hyperbolic about each of those roles, to be partial, or to present either as a reason for optimism or pessimism. These roles are entangled, in uncertain, undetermined and contradictory ways. And clearly, it would be misguided to presume that rural and urban are not related, or that cities can somehow be severed from the multiple connections, flows, and tendrils which link them to their hinterland. I do claim, however, that the urban is a salient sphere of action, and that it is fair to understand the present as an urban age.

Whether cities are understood as engines or stages, beneficiaries or victims, culprits or heroes, the urban, in both its local and its planetary expression, is a fulcrum in which multiple pathways for transitions or transformations can be enabled or foreclosed.

1.2.1 Sustainability transitions

Against this backdrop, an urban-and-transformational turn has been underway in the academic and practical discourses about addressing climate change and embedding sustainability (Burch et al., 2018; Koch et al., 2017; Wolfram et al., 2017; Wolfram and Frantzeskaki, 2016). This growing interest on how to foster, navigate or steer systemic change in cities is not surprising, given the contemporaneous intensification of socio-, technological-, environmental and political change.

A highly diverse body of knowledge has been developing around this issue (Wolfram et al., 2017; Wolfram and Frantzeskaki, 2016), which can be understood as part of an even larger and more fragmented landscape of studies concerned with *transformations towards sustainability* (Patterson et al., 2017; Scoones et al., 2015). Experimentation is one of few themes recurring among different research communities in this domain.

Here, I will focus on the sustainability transitions literature as the backdrop and core academic audience for my research, because:

i) It has produced many of the theories and concepts that helped framing and substantiating these debates with a systemic, multi-actor and long-term perspective on systems change (Wolfram and Frantzeskaki, 2016)

ii) It has pioneered the strategic use of socio-technical experimentation to foster systemic change (Hoogma et al., 2002; Kemp et al., 1998; Schot et al., 1994), later expanded to consider social and conceptual experimentation (Hegger et al., 2007; Witkamp et al., 2011), among other framings (Sengers et al., 2016)

iii) It comprises many internal debates that contribute to a nuanced understanding of the contexts in which experimentation emerge (Geels and Raven, 2006; Longhurst, 2015; Sengers and Raven, 2015), including a recent debate on the geography of transitions that foregrounds cities (Frantzeskaki et al., 2017; Hodson et al., 2017; Hodson and Marvin, 2010)

iv) when compared to other approaches, it stands out for entertaining the possibility of triggering and proactively shaping transformations (Patterson et al., 2017)

The sustainability transitions framing represents an expansion of both the analytical and problem framing when compared to previous approaches to innovations for sustainability (Smith et al., 2010). And even among just one such community, there is considerable diversity of positions (Loorbach et al., 2017; Markard et al., 2012). Further extending the frame of analysis would likely produce diminishing returns.

The sustainability transitions research community is thus well positioned to contribute to debates about systemic change in cities. This academic community is primarily represented by a 1600-strong Sustainability Transitions Research Network (STRN), of which I am a member since 2014, and steering committee member since June 2018.

Since the late 1990s, transition scholars grapple with trying to understand and enact systemic change, with a purpose that is orientated towards contributing to sustainability (Geels, 2004a, p. e.g.; Grin et al., 2010; Hoogma et al., 2002; Kemp et al., 1998; Smith et al., 2005, 2010). This body of work emerged from an amalgamation of different theoretical ideas stemming from evolutionary economics, institutional theories, science and technology studies, and history of technology. Its efforts have been framed as a way of addressing 'persistent problems' and grand challenges that arise as the 'dark side of dominant patterns of socio-economic-technological development' (Grin et al., 2010, p. 2), understanding that these problems arise from 'processes which are firmly embedded in societal structures' (p.3). In that sense, this community advances a contextual perspective of innovation that is apt for describing how innovations can contribute to system change and why it progresses in particular directions.

From its inception, the field was primarily concerned with transitions in socio-technical systems (Elzen et al., 2004; Grin et al., 2010; STRN, 2010), drawing analytical boundaries around 'societal domains' or 'systems of provision' such as

energy, food, mobility, and healthcare. These are understood as *multi-dimensional* and *co-evolving* systems, composed by multiple heterogeneous elements such as 'technologies, markets, user practices, cultural meanings, infrastructures, policies, industry structures, and supply and distribution chains' (Köhler et al., 2017, p. 5).

A foundational insight of the field has been using the notion of socio-technical regimes to address the restricted and focused nature of socio-technical change (Geels, 2002, 2004b; Kemp et al., 1998; Rip and Kemp, 1998). It aims to capture the dominant and change resistant configurations of a focal societal system. This concept was primarily inspired by the related notions of technological regimes, technological paradigms and technological trajectories which emerged in Evolutionary Economics (c.f. Dosi, 1982) as a way of explaining direction of technological change. These notions seek to capture the cognitive paradigms which implicitly informed the work of engineers and technologists, akin to scientific paradigms which implicitly guide scientific research (Kuhn, 2012). Rip and Kemp (1998) and Kemp et al. (1998) expanded on that notion by incorporating a quasi-evolutionary perspective which expanded the analytical focus to encompass both the 'paradigmatic framework of engineers' and the wider societal 'selection environment':

> … the restricted (focused) nature of socio-technical change is accounted for in large part by the embedding of existing technologies in broader technical systems, in production practices and routines, consumption patterns, engineering and management belief systems, and cultural values – much more than it is by engineering imagination. This embedding creates economic, technological, cognitive and social barriers for new technologies
>
> (Kemp et al., 1998, p. 182)

Geels (2002, 2004a) further expanded on this notion, highlighting the coordination which emerges between many social-groups (e.g. scientists, users, policy-makers, and special interest groups). The concept of socio-technical regimes is used to probe the meta-coordination and alignment which emerges from the co-evolution between different sets of regulative, normative and cognitive rules which guide the action of these social groups (Scott, 1995). Unless this alignment is shaken, socio-

technical systems evolve along dynamically stable trajectories that induce path-dependence and lock-in (Berkhout, 2002; Unruh, 2000; Walker, 2000). Innovation in socio-technical systems are aimed primarily at 'regime optimisation rather than regime transformation'(Kemp et al., 1998, p. 182) and tends to be incremental, contributing to cumulative technological trajectories (Grin et al., 2010). Left unattended, regime optimisation aimed at reducing unsustainability could help entrench (i.e. routinise, normalise, institutionalise) unsustainable practices, thus producing persistent problems such as air pollution, climate change, and so forth, adding to the lock-in (Frantzeskaki and Loorbach, 2010a).

Hence, the literature has concentrated on *socio-technical transitions,* the set of processes that lead to a radical regime shifts from one system configuration to another (Grin et al., 2010). A key focus of the literature has been on identifying potential strategies for changing, modulating or circumventing the prevalent selection environment in a given societal domain, from one that (de)selects radical sustainability innovations to one that privileges them. Due to the multi-dimensional characteristic of socio-technical systems, there are no purely 'technological transitions' that do not involve changes to user practices or institutional structures (Markard et al., 2012). Transitions are *multi-actor* processes, involving various social groups and are therefore subject to contestation and competing interests about the directions of change (Grin et al., 2010). Such processes are radical in scope, but not necessarily abrupt. Instead, they are often long-term, multi-decadal processes, with long phases of pre-development before innovations of a systemic nature can break through the multiple barriers that constrain radical innovations (Geels, 2002; Kemp et al., 1998). For that reason, much of transitions research has been informed by ex-post historical analysis (e.g. Geels, 2002; van Driel and Schot, 2005). Early on, the literature went beyond diagnosing the problem, proposing different ways for constructing alternative transition paths (Kemp et al., 1998, 2001; Rotmans et al., 2001).

Hence, *sustainability transitions* have been considered as synonymous with regime shifts which lead to changing the trajectories of socio-technical systems towards more sustainable modes of production and consumption (Markard et al., 2012).

Research in the field is broadly organised along four interrelated strands, which differ in emphasis and use. I review here the three most pertinent to my study: the multi-level perspective (MLP), strategic niche management (SNM), and transition management.

Multi-level perspective

The *multi-level perspective* (see Geels, 2002, 2004a, 2005, 2010, 2011; Grin et al., 2010; Kemp et al., 1998; Rip and Kemp, 1998; Schot, 1998; Smith et al., 2010) has been a prevalent way of analysing past and present transition processes. It argues that 'transitions come about through the interactions between processes happening at different [analytical] levels' (Grin et al., 2010, p. 24): socio-technical landscape, socio-technical regimes, and niches.

The socio-technical landscape represents the exogenous environment that stands beyond the reach of regime or niche actors, but within which they are embedded. It comprises factors that hardly change or which change slowly, such as long-term trends, and rapid external shocks (van Driel and Schot, 2005).

The socio-technical regime, as described above, represents the semi-coherent and dynamically stable complex of rules formed by the alignment across multiple dimensions (technological, socio-cultural, scientific, policy, production networks and industry structures, user practices and market, see Geels, 2004a; Grin et al., 2010). The regime acts as a selection environment, that rejects many innovations (e.g. a single occupant low-speed electric vehicle) but retains those which have better fit with existing rules and user expectations (e.g. a more fuel-efficient Sport's Utility Vehicle).

In this model, niches are thought as the locus of radical innovations: they are spaces where it is possible to deviate from the prevalent rules of a given regime (Kemp et al., 1998; Schot and Geels, 2007) that therefore allow for experimentation that many lead to the emergence of socio-technical configurations with a better fit to a changing selection environment. Thus, the interactions between landscape factors (e.g. climate change and air pollution as matters of concern) and socio-

technical regimes may open windows of opportunity that allow for trajectories to be changed and news to become embedded. The analytical categories articulated in the MLP are a touchstone for the other strands.

Strategic niche management

Strategic niche management (SNM) is a closely related strand that concerns stimulating the development of niches as a way of stimulating radical innovations (Hoogma et al., 2002; Kemp et al., 1998, 2001; Raven, 2006; Raven et al., 2010, 2016b; Schot and Geels, 2008; Schot and Rip, 1997; Smith and Raven, 2012; Weber et al., 1999). SNM has been used both as an analytical tool to study the development of niches and as a governance tool (Raven et al., 2010; Weber et al., 1999). Building on the MLP, SNM scholars sought to develop and understanding of the processes implicated in niche creation and niche formation, and the interactions with regimes which could be exploited to open space for more radical socio-technical configurations to emerge. Early own, Schot et al. (1994) and Kemp et al. (1998) identified the need for experimenting with alternative socio-technical configurations as one possibility for stimulating the development of niches. This strategy differed from other approaches to stimulate system change, such as creating incentives for markets or planning new systems, in that its aim was

> (…) to build on the on-going dynamics of socio-technical change and exert pressures so as to modulate the dynamics of socio-technical change into desirable directions (…) the task of policymakers is to stimulate that the co-evolution of supply and demand produced desirable outcomes (…) Rather than laying down requirements, they need to engage in process management (…) aimed at changing the rules of the game, creating room for experimentation and variation, at shaping the interactions, at making sure that the process is not dominated by certain actors, at learning about problems, needs and possibilities, and at keeping the process of change going in desirable directions.
>
> (Kemp et al., 1998, p. 185)

Protection, as initially thought of in SNM is largely organic, in that it arises from selective environments which policy can contribute to strengthening but which they cannot control. In this sense, Kemp et al. (1998, p. 186) argued that ‘niches are

platforms for interaction; they emerge out of a process of interaction shaped by many actors. They cannot be controlled.' The role of policy in this context can be understood as modulating and enhancement of those conditions, as well as strategically initiating a series of experiments, supporting learning, and building a constituency of support, and inducing changes to the institutional context to facilitate economic success of new technologies.

Nevertheless, the literature was ambivalent about what protection means and how it is achieved, and whether niches are created, formed or emerge. Geels and Raven (2006) developed a process model to explain the emergence of a niche highlighting the recursive relationship between projects conducted by local networks of actors (often referred to as experiments), and the emergence of a 'global' or 'cosmopolitan' level trajectory, through which learning from multiple projects gradually consolidates and gains momentum. This emerging trajectory, in turn, provides further protection for new projects.

Later, Schot and Geels (2008) expanded on the key dynamics associated with niche formation, in which actors could proactively intervene:

- network formation (aiming for *broad* networks with many actors and *deep* networks with considerable resource commitments)
- articulation of expectations and visions
- second-order' learning, through which the actors involved could change their assumptions.

Smith and Raven (2012) further systematised the understanding of how niches are formed, to unpack in which ways they act as 'protective spaces' for path-breaking innovations. They introduced the important distinction between shielding, nurturing and empowerment, to capture the processes through which protective spaces and their proponents shield innovations from the selective pressures from regimes, support the development of these innovations, and advocate for those innovations become inserted or transform the socio-technical regime. We will revisit this in first (section 3, p.79) and second papers (section 4, p.127).

Albeit SNM has been initially discussed as a management tool (hence the name), the processes it described are often used to analyse the formation of niches wherein no purposeful or explicit management happened. This secondary usage is in effect closer to the objectives of this thesis, in which I am particularly interested in the formation of favourable environments for experimentation in particular cities. As the first paper will show, however, adapting the discussion is necessary to take develop a place-based perspective.

Transition Management

Transition management, in turn, was developed as a set of governance tools aimed at purposefully creating dedicated transition arenas, where front-runners can envision and jointly experiment with new pathways to sustainability (Frantzeskaki et al., 2012; Loorbach, 2007; Loorbach and Rotmans, 2010; Nevens et al., 2013; Roorda et al., 2014; Rotmans et al., 2001). It stresses the need to develop a combination of anticipative and adaptive capacity, among a network of participants. In Loorbach's (2007) rendering, transitions management combines: i) a selective participation (based on competencies, backgrounds and ambition for innovation), ii) a long-term collective goal setting and anticipation iii) with the aim 'to initiate a transition of a societal system by stimulating instability and change through promoting changes in structures, cultures and practices simultaneously' (p.89). In that sense, transition management differs from SNM by placing more emphasis on a transdisciplinary engagement to facilitate the process of vision and goal setting, experimentation and reflexive governance to attain the envisaged transition. It is also only partially analogous to the consensus-based, participation-centric modes of policy making, such as the Dutch 'polder-model', instead 'opting for consensus on long-term sustainability goals, while at the same time allowing for diversity and informed dissent in the short term.' (Loorbach, 2007, p. 85).

Scholars writing about transition management have also made important contributions to thinking about experimentation. van den Bosch and Rotmans (2008) defined 'transition experiments' as 'an innovation project with a societal challenge as a starting point for learning aimed at contributing to a transition'

(p.17). These experiments differ considerably from which how most technology pilots are framed. However, ideal type transition experiments are rare; in practice, what we find are hybrids.

Table 1.1 Distinguishing features of transition experiments and classical innovation experiments as ideal type (adapted from van den Bosch and Rotmans, 2008)

	Classical innovation experiment	**Transition experiment**
Starting point	Possible solution or innovation – how to ready it to market	Societal challenge – how to address persistent problem
Nature of problem	A priori defined and well-structured	Uncertain and complex
Objective	Innovation – identifying suitable solution	Transition – contributing towards societal change
Perspective	Short and medium term	Medium and long term
Method	Testing and demonstration	Exploring, searching, and learning
Learning	1st order learning (task and performance oriented), single domain, individual	2nd order (reflexive, challenging assumptions and problem framing), in multiple domains, and collective
Actors	Specialised staff (e.g. researchers, engineers, professionals)	Multi-actor coalitions from across society (transition arena)
Experiment context	(Partly) controlled context	Real-life context
Management context	Classical project management - focused on delivering project goals	Transition management - focused on societal transitions vision

This framing of experimentation is most relevant in contexts in which the scholar is co-creating experiments with other stakeholders. As the section 1.2.5 will show, in the domain of urban experimentation, this form of experimentation is one among many.

There are clear overlaps between these three strands, particularly in their appreciation for the importance of stimulating experimentation, and concern over finding ways to circumvent the obduracy and path dependency of a given socio-technical regime. Theirs is a difference in emphasis. Two divergence points are relevant here. First, the extent to which a consensual long-term vision is seen as an *outcome of* or *requisite for* experimentation. Second, whether the emphasis lies on engaging with experiments happening 'out there' and accelerating the

formation of a niche, versus initiating experiments among the participants of the transition arena.

In the remainder of the thesis, I will draw primarily on the SNM literature as it is more amenable to study the formation of experimentation settings 'organically', without a guiding vision (see section 1.2.5, p.37). Nevertheless, where possible, I will maintain a dialogue with the experimental side of transition management.

1.2.2 The sustainability and politics of transitions

Across these strands, the concepts of sustainability and sustainable development and sustainability are most often evoked as a 'open-ended orientation for change' that imply a 'quest for new values systems' (Grin et al., 2010, p. 2). The literature does not gather around a tightly defined set of indicators or defined end-goal for sustainability. Sustainable development is best understood as a 'multi-dimensional bridging concept', which is effective because of this 'open texture' (Meadowcroft, 2000). By and large, this discourse can be

> (…) understood to embody ideas about promoting the human well-being, meeting the basic needs of the poor and protecting the welfare of future generations (intra- and inter-generational justice), preserving environmental resources and global life-support systems (respecting limits), integrating economics and environment in decision-making, and encouraging popular participation in development processes.
>
> (Meadowcroft, 2000, p. 373)

The accent given and specific meaning attributed to each of these aspects varies widely and is intertwined with ideological premises (c.f. Dryzek, 2013). Specifying each of these dimensions, and negotiating the potential tensions and trade-offs is of course inherently political and contested, as it evokes radically different understandings and narratives of what the future of particular systems ought to be, which also change over time (Leach et al., 2010).

Nevertheless, the relatively open commitment to sustainability but implicit treatment of politics in transitions research has been repeatedly criticised for a political naiveté and normative ambiguity. For Meadowcroft (2011), transition

studies have largely focused on policy but neglected the political circumstances (i.e. the complex of societal interests, institutions, and ideas or ideologies) that make such policies viable. In its claims of common interest, shared and singular Nature, and apocalyptical urgency, sustainability is always at risk of being portrayed as a post-political affair (Swyngedouw, 2010, 2011), and transitions is no exception.

Attending to this issue, Shove and Walker (2007) note that whilst many of the MLP analysis tend to be distanced and 'voyeuristic', transition management and efforts to build and shape niches deserve caution about their own politics. In particular, these authors highlighted issues regarding problem framing, participant selection, managers positionality as part of the systems in question - their expectations about participation and their assumptions about consensual visions (see also Smith and Stirling, 2008):

> It is necessary to recognise that provisional templates for transition are political statements that can only be partially inclusive … contingent (when conditions are dynamic), and potentially unstable as material forms.
>
> (Shove and Walker, 2007, p. 766)

Responding to that criticism, Rotmans and Kemp (2008) stressed that transition management was meant as a way for reflexively exploring new paths, not a way for delivering on blue-prints for the future through social engineering. Nevertheless, in transition management, emphasis is placed on developing a shared long-term agenda as a way of convening a transition arena and begin a process of 'backcasting' possible pathways.

Dissent and conflict are perceived primarily as hindrances, generative only in so far as it helps explore different avenues for search. 'The transition agenda more or less needs a certain element of dissent, conflict and difference of opinion so that it facilitates innovation, competition and learning' (Loorbach, 2007, p. 121). However, as the transition arena is a convened space, overt conflict threatens its foundational mode of operation. In this vein, Kemp et al. (2007) assessment of the hindrances to steering: 'dissent and ambivalence about goals', 'dealing with uncertainty',

'distributed control', 'political myopia', 'determination of short steps for long term change' and the 'danger of lock-in'.

More recently, Raven et al. (2017a) demonstrated that extreme caution is needed in assuming 'any objective status for the "sustainability" of particular experiments' (p.594), given the diversity of criteria, uncertainty and priorities of different stakeholder groups, and different contexts in which they arise. The very choice of which 'niches' or 'cases' transition scholars highlight is also normative and deserving of reflexivity (e.g. privileging electric vehicles in detriment of slower forms of mobility).

Scrase and Smith (2009) questioned this implicit assumption of consensus. They caution about the risk of capture as the approach emphasises 'consensus amongst an elite vanguard, a niche-based momentum for change, and reliance on integration with more powerful policy domains' (p.724). Instead, they argue that more attention is necessary to the possibilities for (mass) *mobilisation*, because

> groups in society are perpetually trying to develop niche alternatives and pressure incumbent regimes in many different ways and with differing levels of agency and influence. A messy, informal transition politics already exists.
>
> (Scrase and Smith, 2009)

Hence, by overemphasising consensus, the literature is at risk of neglecting the extent to which dissensus, and in some cases, conflict is also generative for systemic change.

Without heeding to these concerns, transitions research is at the risk of either downplaying, mischaracterising or instrumentalising a vast sway of potentially transformative activities that have been collectively characterised as 'grassroots innovations' or 'grassroots innovation movements' (Hossain, 2016; Seyfang et al., 2014; Seyfang and Smith, 2007; Smith et al., 2014, 2017; Smith and Seyfang, 2013). These are 'networks of activists and organisations generating novel bottom-up solutions for sustainable development' (Seyfang and Smith, 2007, p. 585). Some of the iconic environmental innovations, such as solar collectors, wind power and car

sharing, have at 'part of their roots and foundational phase in civil society and grassroots movements' (Ornetzeder and Rohracher, 2006, p. 865). Organic food (Smith, 2007), veggie boxes (Purdue et al., 1997), community energy (Seyfang et al., 2014; Seyfang and Haxeltine, 2012), and community currencies (O'Doherty et al., 1999; Seyfang and Longhurst, 2013) are but few examples of the potential for radically novel and potentially transformative grassroots innovations. Grassroot groups also aim to contribute towards urban sustainability (Håkansson, 2018; Wolfram, 2018a).

These initiatives and networks are promising for transitions but are often at odds with mainstream understandings of science, technology and innovation. Hence, the encounter between grassroots innovations actors (civil society, NGOs, social movements, cooperatives, community groups) and mainstream innovation actors (e.g. universities, innovation agencies, ministries and public institutions) is fraught with difficulties (Fressoli et al., 2014; Smith et al., 2014, 2017). Fressoli et al. (2014) and Smith and Ely (2015) highlight the discrepancies in regard to how grassroots innovation movements and mainstream institutions understand technology and innovation, involving different actors, values, incentives, investments, and forms of knowledge, sites of innovation and forms of knowledge that are considered legitimate. Navigating this boundary encounters between them requires a reflexive engagement from the part of transition scholars and policymakers, aware of the politics of knowledge involved. These authors highlight two distinct modes of engagement, *insertion* and *mobilisation*, associated with the fit-and-conform and stretch-and transform modes of empowerment (Smith and Raven, 2012).

Insertion, viewed from the bottom-up, is concerned with fitting grassroots innovations in 'prior spaces of innovation and playing by or adapting to the rules of dominant institutions, technologies, regulations, etc.' (Fressoli et al., 2014, p. 7). From the top-down, it occurs as mainstream institutions attempt to 'insert and capture ideas, elements and even models from grassroots innovation movements, adapting them to their own agendas and practices' (p.7).

> [The] insertion view positions grassroots innovation as generating appropriable object solutions (technological artefacts or social innovations), often accompanied by a desire to select and scale up those that look promising under prevailing institutions of science, technology and innovation.
>
> (Smith et al., 2015)

In contrast, it is possible to envisage an engagement whereby grassroots innovations take aim at reshaping the institutional priorities of incumbents and mainstream organisations. In doing so, they are often faced by 'awkwardness or unfamiliarity' from elite institutions unprepared and impervious to other perspectives in innovation and sustainability (Smith et al., 2015). Hence:

> mobilisation implies direct attempts to transform the spaces of innovation by challenging the dominant practices, technologies, power relations and [that] may eventually force the incumbent regimes to change *their* models, and/or lead to autonomous experimentation with new socio-technical arrangements
>
> (Fressoli et al., 2014, p. 7)

Hence, there have been multiple calls for transcending a somewhat monolithic and apolitical view of 'the' sustainable transition or 'the' low carbon transition. Public discourse about transitions often presume that it is possible and desirable to encounter a normative direction is broadly shared, assuming that transition can only occur once there is broad agreement and political will, with high degrees of coordination across multiple policy domains. For Stirling (2014, 2011) the notion of transitions as presented in the literature emphasises teleological understandings and is therefore is amenable to efforts to carry out systemic change (e.g. green revolution, nuclear energy expansion) that is

> driven by technological innovation, managed under orderly control, by incumbent structures according to tightly-disciplined frameworks for knowledge, towards a specific known (presumptively shared) end
>
> (Stirling, 2014)

The criticism by Stirling (2014, 2011) suggests that more heated 'agonistic' forms of political engagement (c.f. Mouffe, 1999, 2000) are necessary to open up possibilities for progressive and emancipatory sustainability transformations while also helping

to revitalise democracy. However, whether this is always the case empirically is far from settled. It is thus important to endogenise the question of whether and how conflict and contestation play out in ongoing processes of systemic change.

Transitions' research is starting to show signs that it is deviating from notions of tight control or instrumentalism, and becoming more politicised. As a recent review by Loorbach et al. (2017) points out, the scope of transition's research has been expanding in various directions; it is now more multi-focal and diverse in its fundamental assumptions. A body of literature has emerged to cover the politics of transitions, particularly in regards to transition management, which far exceeds what we can cover here (c.f. Avelino, 2017; Avelino et al., 2016; Avelino and Rotmans, 2009; Jhagroe and Loorbach, 2014). There has been growing attention to research on societal systems, rather than primarily technological systems, more generally, including regions, and cities (e.g. Frantzeskaki et al., 2017; Hodson and Marvin, 2010; Späth and Rohracher, 2010). There have also been more efforts to bridge the socio-technical perspective with socio-ecological (e.g. Smith and Stirling, 2008), and more overtly socio-institutional and political approaches (Brown et al., 2013; Fünfschilling, 2014). And transitions research has increasingly been seen as a one component of a wider set of approaches necessary for reflexively governing sustainability (Voß et al., 2006). Moreover, many transition scholars have become more open to engagements with debates about the prospect of sustainability transformations, exploring the theoretical and practical implications of different problem framings and assumptions about the dynamics of system change.

The field is also opening up to the variety of trajectories and imaginaries of the future, for which the notion of 'pathways' is increasingly evoked (Rosenbloom, 2017). Gradually, the community has accepted the notion that there are *multiple potential pathways* through which transitions could occur. Pathways have been used to describe different patterns and sequences of processes that could culminate in a transition (Bai et al., 2010; Geels et al., 2016; Geels and Schot, 2007). This notion is also used to evoke the plurality of futures which could be pursued, depending on how systems are framed, and their dynamics are understood and

acted upon, thus highlighting the political and deliberative processes which may open and foreclose certain avenues (Leach et al., 2010, 2012).

Nevertheless, it is still a common (and implicit) assumption that transitions can be initiated, steered and navigated primarily through policy making, rather than by other means for political action (e.g. social movements). In doing so, transition studies tend to bypass (for good and for bad) discussions about the underpinning causes of unsustainability or the political structures implicated in reproducing it. By focusing primarily on ongoing change in particular systems of provision, and relegating wider political structures, ideologies and long-term developments to the 'landscape', transition scholars reiterate the unspoken premise that profound changes are possible within the bounds of current society.

Other socio-scientific research traditions drawing from critical theories take on explicit forms of critique (e.g. critical geography), and embrace a radical political stance that question the fundamental aptitude of current society (e.g. capitalism in its neoliberal form) to address the issues it generates. However, those same traditions do not see as their task to discuss concrete steps or ways forward for pressing policy challenges. That very stance hinders attempts to translate those critical finding into actionable knowledge which could inform policy-making.

From criticism about the politics of transitions, I take forward three points raised in this section:

- The need to engage the messy, unruly, contested, actually-existing efforts to bring about transitions, without a priori assuming the viability and desirability of these processes
- The need for observing whether and how conflict and dissent may be generative or disruptive to experimentation
- The need for going beyond *insertion* and the emphasis on scaling up innovations to consider more carefully the forms of *mobilisation* which may be of relevance for urban experimentation

1.2.3 The geography of sustainability transitions

Another point of contention in the transitions' literature have been its geographical assumptions. Traditionally this community assumed that transitions can be best studied and governed at the level of nation-states, drawing analytical boundaries around systems of provision that are domain-specific (e.g. energy, mobility, water, health-care). These assumptions have since been challenged by a variety of geographically-informed studies collectively referred to as the 'geography of transitions' (Bridge et al., 2013; Coenen et al., 2012; Coenen and Truffer, 2012; Hansen and Coenen, 2015; STRN, 2010; Truffer et al., 2015; Truffer and Coenen, 2012).

Around the time of the inception of the STRN, two related concerns motivated the interest on the geography of transitions and created a fertile ground for research. First, by disregarding geographical categories such space, place and scale, 'geographical context is treated at best as a passive background variable providing little causal explanation or theoretical purchase' (STRN, 2010, p. 18). An explicitly geographical perspective was thought as necessary 'to disclose the contingencies and particularities' (p.18) of the contexts wherefrom transitions unfold (which has ever since referred to as place-specificity, see Hansen and Coenen, 2015). Second, there was a concern with the implicit treatment of scales - e.g. by assuming that regimes are nationally structured, while niches are considered to be local, as in the local-global argument in strategic niche management. Such approach suggested that 'transitions can take place anywhere, thereby neglecting the advantages, conflicts and tensions of the spatial realities within which transition processes are embedded' (id., p.18). Put succinctly, they neglect how 'places produce transitions and transitions produce places' (STRN, 2010, p. 18).

Ever since, these salient points have inspired a burgeoning literature, and carved out an increasing space within the transitions field (c.f. Hansen and Coenen, 2015; Truffer et al., 2015). The geography of transitions' central contribution has thus been

> to stress the importance and role that socio-spatial relations, knowledge and material flows, and geographically situated institutional features play in facilitating or obstructing transitions process
>
> (Murphy, 2015).

For Bridge (2013), the value of treating transitions as a geographical process is that it changes the questions which researchers ask.

> Viewed through the lens of time, key questions about transition include the different temporalities of technological and policy innovation, the rates at which particular energy technologies may be mainstreamed, or the evolution of consumption behaviour. By contrast, a geographical perspective on transition foregrounds questions about spatial difference (and the co-existence of multiple transition pathways and possibilities).
>
> (Bridge et al., 2013, p. 339)

Particularly salient here is the role of places in shaping transitions processes whilst being shaped by then (STRN, 2010). Notably, Murphy (2015) argued place figures implicitly in transitions research 'as a contiguous site, territory, or spatial container wherein socio-technical systems are located' (p.83). Drawing from Agnew (1987), they see place as a phenomenon with dimensions of locale, location and affect (often referred to as site, situation and sense of place). Places are thus conceptualised 'as phenomena constituted by webs or constellations of external and internal relationships which in effect "make" them' (p.84). Hence the potential for theorise transition processes or experiments as 'place-making' that examines the efforts of actors to frame and modify a place's meaning and its future possibilities (Håkansson, 2018; Martin, 2003; Pierce et al., 2011).

According to a recent review, however, research has largely focused on the geographic unevenness of niche development highlighting a variety of potentially relevant place-specific factors such as distinctives urban or regional visions for transitions, the endowment of local resources, place-specific formal and informal institutions, path-dependent patters of local specialisation, and the specifics of local market formation (Hansen and Coenen, 2015). Most studies have 'layered on top of existing theory' (p. 105), without challenging the underlying categories.

Thus, this strand of research highlighted the importance of place-specificity but has yet to produce generalisable knowledge about how place-specific formations come to influence transitions (Hansen and Coenen, 2015). In such calls, what generalising the (place-) specific means, however, is still unclear, and is presented as a matter of more systematic study and better comparison.

But rather than systematically exploring these questions, research has been evolving along rather incongruent lines, around distinct problems and audiences. There has been an effort to 'zoom in' on urban and subnational transitions and transformations, to relate more closely with the efforts of municipalities and grassroots groups and engage with other understandings of systemic change in the city (see section 1.2.4, p.32). Some scholars have been trying to follow the emergence of niches transnationally, through multiple spatial contexts (e.g. Carvalho and Lazzerini, 2018; Fontes et al., 2016; Sengers and Raven, 2015). Others have sought to pan towards transitions in developing nations, questioning the presumed universality of transition concepts (Hansen et al., 2018; Lawhon and Murphy, 2012; Ramos-Mejía et al., 2016; Wieczorek, 2018). Others still have 'zoomed out' into the global understandings of transitions (Binz et al., 2014, 2015; Fuenfschilling and Binz, 2018).

Revisiting the geographical assumptions of transitions research galvanised new areas of inquiry, but it is far from generating a geographical theory of transitions. There has been little cross-fertilisation among these perspectives, and little reflexivity about what the geography of transitions entails in practical terms. For the moment, debates risk becoming a largely meta-theoretical exercise of combining geography and transitions, around unspecific expectations for 'spatially explicit' or 'geographically sensitive' theorising. Attempts to make space, place, or scale explicit in transition studies have been beset by the sheer heterogeneity in how these concepts are dealt among geographers (Hansen and Coenen, 2015; Murphy, 2015). Bundling these disparate geographical perspectives as a separate sub-field risks reinforcing the impression that 'real' transitions are the ones happening in northerly and western countries, at the national level.

Given the breath of transitions theory, the contested nature of geographical concepts, and the lack of a clearly defined audience for the geography of transitions outside the academic realm, I argue that a more specific framing is required.

1.2.4 Urban Sustainability Transitions

By and large, contemporary scholarly interest in urban experimentation is motivated by the possibility that it might contribute to enabling, navigating or even triggering systemic change in cities despite the uncertainty and ambiguity associated with challenges they face. In this section, I review the emerging scholarship on urban sustainability transitions, to understand what such a perspective may bring.

Systemic change in cities is a crucial but still downplayed subject among the transition's community. As seen before, the pervasiveness, simultaneity, and complexity of the challenges outlined under the banner of the Anthropocene suggest that cities around the world will be facing a prolonged period of turbulence, requiring reconfigurations to many of their underlying socio-technical systems, but equally important, of their governance (Burch et al., 2018). Notwithstanding, urban transitions were mentioned only passingly in the STRN Manifesto (STRN, 2010) and remains a relatively marginal aspect of its latest agenda (Köhler et al., 2017). A dedicated volume on 'urban sustainability transitions' is a recent addition to the Routledge book series which chronicles the development of this field (Frantzeskaki et al., 2017).

Only in October 2018, and in part through my advocacy, the STRN launched Urban Transitions and Transformations thematic group, motivated by the 'conceptual fragmentation and contradiction in the current literature, with a burgeoning volume of empirical material but less aggregation, cross-case comparison or theoretical development' (STRN, 2018).

Compared to transitions' main body of work, research on urban sustainability transitions tends to foreground the ambitions, interests and challenges encountered by urban stakeholders (e.g. urban dwellers, municipalities, local

government officials, local companies, place-based civil society) in the pursuit of systemic change that is relevant to their cities. For the inhabitants, government officials or community groups in of Bristol or Medellín, it matters whether their city undergoes energy transitions towards more affordable, sustainable and locally produced renewables, or if their city is capable of bringing mobility services to areas previously excluded, regardless of national-level transitions. There is an immediacy of these processes which can be galvanising and create distinctive political opportunities and constraints. After all, it is their daily routines and practices which will be enabled or hindered, and their living space which will be made warmer or cooler, their commutes shorter or longer, their cities wealthier or poorer.

Early on, research grappled with trying to understand the role of cities in transition processes. In a seminal article, Hodson and Marvin (2010) asked 'can cities shape socio-technical transitions and how would we know if they were?'. The authors explored the relationship between the MLP and world cities (Sassen, 2000), and encountered evidence of 'attempts to purposively reconfigure socio-technical systems of infrastructure provision' (p.478) but argued that the role of cities in transitions is 'uncertain, fragmented and often implicit' (p.40). Drawing from Smith et al. (2005) discussion on the distinct contexts for transitions, and highlighting a variety of (landscape) pressures which influence urban transitions, they argued that studies need to engage with:

> 1. How the pressures are experienced and perceived in a particular city and by whom and how this translates in to a shared understanding of an urban socio-technical transition;
>
> 2. The current and historic organisation of infrastructure in relation to a city and the level of capacity and capability to develop and operationalise this shared understanding processually; and
>
> 3. The degree of learning that takes place within and about the urban transition
>
> (Hodson and Marvin, 2010, p. 481)

These authors further problematise the idea of a shared vision for urban transitions. The pressures which impinge on cities engagement with transitions

are very different from those which motivate stakeholders at other governance levels. Recognising cities' embeddedness within multi-level governance arrangements, and the fact that neither cities nor socio-technical regimes are monolithic, they highlight that these visions have to translate and negotiate between the changes envisaged in a nationally or internationally organised socio-technical regime and the territorial priorities of different actors. Hence, when thinking about urban sustainability transitions it is crucial to interrogate *who is producing the visions of the future* and *'who is it that speaks on behalf of the 'the city'*, and *'whose interests and priorities shape interventions and how'* (Hodson and Marvin, 2010, p. 482; see also Späth, 2012; Späth and Rohracher, 2010, 2012). For that reason, many authors stressed the importance of intermediaries for mediating between different priorities and enabling their implementation (Gliedt et al., 2018; Hodson et al., 2013; Hodson and Marvin, 2010; Kivimaa, 2014; Matschoss and Heiskanen, 2017; Moss, 2009).

Much research has ensued along these lines, which is nevertheless hard to characterise. In general, it 'does not boil down to the niche-regime-landscape triumvirate' (Rutherford and Coutard, 2014, p. 1368). It also does not follow strictly the divisions between different strands of transitions research. It goes beyond assuming that urban transitions are simply those that are mediated by localised forms of government (Frantzeskaki et al., 2017). It opens avenues into what pathways (patterns of change and directions of change) are made possible or hindered by the engagement of cities and their governments with transitions (e.g. Coutard and Rutherford, 2010; Monstadt and Wolff, 2015; Rutherford and Coutard, 2014; Rydin et al., 2013). It reveals particular attempts and possibilities for governing such processes (Bulkeley et al., 2015b). And it creates opportunities for novel forms of engagement by transdisciplinary researchers (e.g. Hölscher et al., 2017; Nevens et al., 2013; Roorda et al., 2014; Wittmayer and Loorbach, 2016).

More recently, in the conclusion of 'Urban Sustainability Transitions', (Grin et al., 2017) pinned down the crucial distinction between these and the common focal points of transition studies. They point out that urban transitions entail complex dynamics that are hardly captured by single frameworks, thus justifying a degree

of 'theoretical promiscuity' and engagements with diverse ways of understanding the urban and identify two points of convergence which explain the distinction. First, treating the *city as the focal unit of analysis*, as opposed to focusing on particular societal domains. Second, *treating this unit of analysis as a (relational) place* (see discussion on the geography of transitions).

This convergence is important because it shines light on processes which are made possible by the co-location of activities within a particular place, while at the same time considering the ways in which these places is co-constituted through relationships and flows from other places and scales. As Frantzeskaki et al. (2017) observe:

> [in the urban sphere] multiple domain transitions intersect and are inter-related. Urban transitions are thus not distinct because they are observed at a different scale, but because they involve the alignment of resources and actor constellations across domains within a given geographical setting. Cities are thus 'natural' sites where the multiplicity of different dimensions concerning sustainability transitions comes together. To make sense of an govern this multiplicity requires city-specific analytical tools.
>
> (Frantzeskaki et al., 2017, p. 2)

Critically, this convergence also highlights the interactions between a variety of experimental activities which are co-located in the city, even when associated with a singular domain (e.g. Hodson et al., 2017; Schwanen, 2015). Here, the emphasis lies in examining how a multiplicity experimental processes contribute or hinder the reconfiguration of socio-technical that underpin urban living. *However, how particular places come to concentrate such multiplicity remains unexplained in much of the literature.*

The motivations for pursuing systemic change in cities vary enormously, comprising disparate trends and challenges. A complete inventory of such trends is of course impossible and not very practical. What is essential, however, is the recognition that cities, by their very nature, could support the emergence of pathways to sustainability and to transitions that are distinct to those that can be pursued at other scales. An energy transition in which cities play an active role –

e.g. rescaling infrastructure provision and ownership to the city scale (e.g. Blanchet, 2015) produce very distinct outcomes. They advance different interests, and different imaginaries of the future. Their end goals are multiple and contested, with multiple potentially complementary and at times competing imaginaries of the city being pursued at once. This has led to a somewhat cacophonic debate about whether transitions would lead are 'low carbon', 'carbon neutral', 'renewable', 'liveable', 'smart', 'green', 'eco' (de Jong et al., 2015). Concomitantly, a variety of other unspoken rationales inform urban transitions, most noticeably the advance of a neoliberal logic that prioritises market solutions and hyper competition between cities (Haughton et al., 2013; North et al., 2017; Oosterlynck and González, 2013). Here, it suffices to say that multiple potential normative agendas are at play in guiding and evaluating the transitions, which are also driven by the (sometimes commercial) interests of different parties. Any such imaginary or vision needs to be taken with a pinch of salt.

That said, there is nothing intrinsically progressive or inevitable about urban transitions. Research on urban transition is not except from the political concerns raised about transitions more generally. Thus, Hodson and Marvin (2010) cautioned that representing a mutual (low carbon) future for the city is always happening in the service of particular social interests. This is true not only for governmental and firm-led interventions, but also for alternative and grassroots experiments, which are always entangled in the socio-material fabric of the city and attempting to modify it, with various consequences. Even seemingly innocuous community gardens are essentially attempting to re-make places and may thus have unintended consequences such as gentrification (Håkansson, 2018). In this vein, Luque-Ayala et al. (2018) argues that a 'second-generation' of urban low-carbon transition studies is required, which can move beyond assuming singular decarbonisation pathway and the search for best practices towards one that 'foregrounds the political nature of the low carbon city, acknowledging multiple and contested developmental pathways' (p.31). A similar observation could be expanded to any other imaginary of what the future city ought to be.

Finally, it is important to recognise cities around the world also have disparate capacities to engage in transition processes. That has motivated many studies concerning the processes that lead to the development of cities capacity to initiate, navigate and enact systemic transitions vary widely (Brodnik and Brown, 2018; Burch and Robinson, 2007; Castán Broto et al., 2018; Hodson and Marvin, 2010; Hölscher et al., 2018; Wolfram, 2016). *We return to this question on the third paper* (p.167).

Interestingly, attempts to bring about urban transition are also subject to a tension between *insertion* and *mobilisation* and the tensions associated with them (see section 1.2.2, p.22). For scholars or stakeholders primarily concerned with national level transitions (Geels, 2011b), it is justifiable to see cities as source of creativity, which can produce best practices for wide adoption, and whose efforts should fit into existing institutional structures, prioritising nationally-agreed targets and goals. However, from the perspective of urban stakeholders primarily concerned with advancing local or urban transitions, those very structures may be inadequate, and those targets unambitious or ill defined. This issue will feature in the discussion about the leveraging of grassroots experiments, in first paper (p.79). Now, we turn with more detail to the crux of this thesis.

1.2.5 Experimentalism and urban experimentation

> 'Metropolis Now: Technology is transforming city life, for better or worse'
>
> (Atlantic, 2018)

> 'To experiment is to act in order to see what action leads to. The most fundamental experimental question is, "What if?"'
>
> (Schön, 1983, p. 145)

For an avid news reader, it is hard to miss the trickle of references urban experimentation. Influential media outlets – e.g. The Guardian, The Atlantic, The New York Times, The Economist, The Wall Street Journal - routinely chronicle cities experimenting with a novel technology, social innovation or governance approach which hold the promise of quasi-miraculous transformations. These

pieces ranges from hopeful and constructive, to dystopic and alarming, recounting the promises and perils of transforming the city. They contrast starkly with the persistency of problems such as pollution, deprivation, crime and housing costs that mark the bulk of the city coverage. In recent years, such coverage has become more frantic, as concepts of smart city have mushroomed and gathered momentum with the support of Silicon Valley's tech giants.

Urban experiments, pilots, demonstrators, and a myriad of similar practices and similar terms are becoming lingua franca among a growing chorus of cities around the world. Establishing designated experimental spaces such as incubators, testbeds, living labs, real-world laboratories, has become an important tool in the portfolio used by local governments trying to induce innovations for sustainability and other goals (Evans et al., 2015; Gliedt et al., 2018; Karvonen and van Heur, 2014; Marvin et al., 2018; Nevens et al., 2013; Schäpke et al., 2018; Scholl and Kemp, 2016; Voytenko et al., 2016). And labelling cities testbeds or laboratories is now a prevalent tactic among those involved in place marketing, and to some extent a synonymous with other principles such as agility, preparedness, innovativeness. Presenting the 'city as a laboratory' is not only a recourse of academics, but also 'an explicit storyline used in municipal policy documents to describe carbon governance within the city, as well as a rallying point underpinning the discourse coalition of the transnational network' (Tozer and Klenk, 2018). Regardless of the specific imaginary or vision it serves, urban experimentation is not solely a mediatic or marketing hype. It has arisen as an important approach to governing the city (Bulkeley et al., 2015b; Bulkeley and Castán Broto, 2013; Castán Broto and Bulkeley, 2013; Evans et al., 2016; Hodson et al., 2018).

To a large extent, urban experimentation is a specific expression of widespread experimentalism, i.e. reliance on or advocacy of experimental or empirical principles and procedures (Merrian-Wester, n.d.), that is emerging as cross-cutting element in various discourses about systemic change for sustainability (Ansell and Bartenberger, 2016; Caniglia et al., 2017). It resonates with experimentation in policy and governance beyond the city, especially in regard to climate change (Hoffmann, 2011a; Jordan et al., 2017; Jordan and Huitema, 2014; Kivimaa et al., 2017;

Laakso et al., 2017). Experimentalism plays multiple roles in recent conceptions of how the governance of complex socio-technical-environmental issues is to be achieved, e.g. adaptive management, and reflexive modes of governance (Voß et al., 2006). It is also manifest across in attempts to bring about transition in multiple domains, such as energy, water, and the built environment, and mobility (Coenen et al., 2010; Farrelly and Brown, 2011; Kivimaa et al., 2017; Weber et al., 1999). The sheer variety is exemplified by the number of reviews, typologies and special issues published in the past three years (Ansell and Bartenberger, 2016; Caniglia et al., 2017; Jordan et al., 2017; Kivimaa et al., 2017; Laakso et al., 2017; Sengers et al., 2016). Books in this domain (Evans et al., 2016; Turnheim et al., 2018a) have also grappled with pinning down what counts as experimental, and the different ways in which experimentalism is being expressed.

Amid an explosion of interest, a 'very loose usage of "laboratory" and "experiment" seems to be the norm rather than the exception (Karvonen and van Heur, 2014). Between 2000 and 2010, 283 articles referred to "urban experiments", compared to 900 between 2011 and 2018 (Google Scholar). Notions of urban experimentation are evoked are evoked in a spectrum that ranges from attempts to remake the city from below, through the 'alterative experiments' of grassroots and Do-It-Yourself urbanism of squatters (e.g. Wendler, 2014), all the way to the top-down large-scale experimental district or even experimental cities such as Masdar city (Cugurullo, 2018). This has led Caprotti and Cowley (2017) to remark that urban experimentation stands as an 'empty signifier, a concept that is defined by its indeterminacy' (p.1), lending itself to a range of political and governance interpretations, ranging from progressive to regressive. Much of the ambiguity stems from the fact that urban stakeholders and scholars are appropriating and experimenting with the very notion of experimentation, at a fast pace, to address their needs. As such, urban experimentation begs critical engagement, not least in its definitional dimension.

As Ansell and Bartenberger (2016) suggests, in the broadest sense experimentation involves acting in order to learn what happens as a result (Schön, 1983, p. 45). But where then lies the promise and specificity of urban experimentation?

Much of the literature agrees with Karvonen and van Heur (2014) assessment on this matter. Drawing from Science and Technology Studies and Laboratory Studies, they highlight three aspects:

- *Situatedness in real-world places*, with porous and often contested boundaries that are collectively negotiated by the researchers among other actors (see Gross and Krohn, 2005). Controlling the context is only partially possible.
- *Change orientation*, marked by a strong normative aim of laboratories to bring about more desirable futures, which is intentionally radical and often positioned in opposition to 'urban-development-as-usual'
- *Embrace of contingency and uncertainty,* in which experiments are understood to be contingent and open-ended, carrying potential risks and rewards, which are tolerable within the experimental context. Although the ambiguity of what a laboratory stands for increases uncertainty, the notion provides 'interpretive frame that can be utilized to make sense of what happens and to offer guidance for action' (Karvonen and van Heur, 2014).

For starters, then, drawing a parallel with urban transitions, we can assume that urban experimentation happens in an urban place, carried out by a coalition of urban stakeholders. However, the intentions and forms of action vary considerably.

Instead of over-specifying what experiments are like, or presenting a rigid typology, however, I want instead to outline the contours of the conceptual '*holding-space*' which I later explore in the papers, by outlining the salient *logics*, *uses* and *loci* of experimentation, considered from the perspective of research that is place-based.

Purposes of experimentalism

In a first approximation to this fuzzy concept, it is important to consider its purported uses. Different epistemic communities tend to take for granted what uses or purposes experimentation has. Ansell and Bartenberger (2016) examined

how experimentalism has been emerging as a 'generic strategy for environmental problem-solving', noting at least six uses (purposes)[1]:

1. Inducement of socio-technical and design innovations to foster sustainability transitions (e.g. sustainability transition and sustainable design)
2. Encouragement of social and political learning[2], and mobilisation of support for sustainability (e.g. transdisciplinary transition scholars, transdisciplinary sustainability scholars)
3. Design and evaluation of institutional and governance arrangements implicated in the governing of natural resource and climate change (e.g. natural resource management scholars drawing from institutional economics, urban governance scholars)
4. Adaptive management of socio-ecological systems in the face of uncertainty and change (e.g. socio-ecological resilience and climate adaptation)
5. Conduct of (basic) research on economic and environmental behaviour, and the valuation of environmental goods (e.g. literature on ecosystem services)
6. Harnessing learning processes as institutional strategy for democratic (environmental) governance (e.g. polycentric governance scholars in Earth System Governance Programme)

The first three uses are relevant in sustainability transitions research. Early on, transitions scholars were primarily concerned with inducing innovation to foster systemic change (Kemp et al., 1998; Sengers et al., 2016; van den Bosch, 2010; van den Bosch and Rotmans, 2008; Weber et al., 1999). However, that task is intertwined encouraging social and political learning (use 2, see Brown et al., 2003; Brown and Vergragt, 2008; Raven et al., 2008; van Mierlo and Beers, 2018; Verheul and Vergragt, 1995). Recent scholarship has also shown that governance

[1] I present them in an order that is most convenient for the discussion. This does not represent a hierarchy.
[2] Ansell and Bartenberger (2016) refer to political learning to highlight that 'stakeholders often have different political preferences and agendas' (p.70), in contrast with epistemic learning, which is concerned with expanding and refining scientific knowledge.

arrangements are a crucial object of experimentation (use 3, see Bos et al., 2013; Bos and Brown, 2012; McGuirk et al., 2015). The other three uses have been relevant for other strands sustainability science (Caniglia et al., 2017) and global environmental governance (Voß and Schroth, 2018).

However, there are good reasons to approach experimentation happening in particular places with a relatively open frame of what is happening. Urban experimentation, when considered in a particular place, is often characterised a multiplicity of initiatives, which interact variably (Hodson et al., 2017; Schwanen, 2015). For example, experiments attempting to induce socio-technical innovation often happen in parallel or require governance experiments, and so forth, and their combination may be required for reconfiguring existing socio-technical systems. The purposes of experimentation are not self-evident, and even for the actors involved. Many of the transformative outcomes of experiments may in effect be emergent outcomes from a variety of experiments, rather than the outputs of singular experiments (Heiskanen and Matschoss, 2018). Therefore, later in this thesis I will refer to environments which favour a multiplicity of urban experimentation along the lines of these three uses.

Logics of experimentalism

Scholarship has been relatively divided among these different uses, with different academic communities advocating for particular forms of experimentation while taking for granted what constitutes an experiment, what forms of inference can be used in for knowledge acquisition (Ansell and Bartenberger, 2016; Caniglia et al., 2017).

The three uses listed above are concerned with proactively engaging in the search for solutions instead of identifying and characterising problems. In that sense, Caniglia et al. (2017) points out are concerned with producing 'evidence-based actionable knowledge' as opposed to 'evidence-based causal knowledge'. They describe this actionable knowledge as *prescriptive*, indicating which solutions to pursue given a vision (instead of descriptive); *procedural*, indicating how to address or mitigate sustainability problems (instead of explanatory); and *synthetic*,

requiring the formulation of a synthetic solution (instead of analytical). However, in the context of transitions, evidence is not necessarily formalised, but to a large extent *experiential* – users, practitioners, engineers encounter in practice other routines and possibilities, which in turn enables 'changes in cognitive frames and assumptions, i.e., second-order learning' (Schot and Geels, 2008).

Ansell and Bartenberger (2016) provides a useful guide to mapping the logics of experimentation. From pragmatist perspective, they argue that experimentation is a key strategy for dealing with uncertainty, as experiments can be used not only to test particular hypothesis of what works (deductively), or identifying alternatives which work (inductively), but also exploring solutions through open-ended cycles interactive refinement of a prototype (abductively). By recognising these different forms of inference, and not fixating on a particular definition, they argue that the meaning and type of experimentation deployed depends on the purpose for which it is mobilised, on what is problematic in a given situation, and on the visions and values which motivate the practice. Ansell and Bartenberger (2016) hence discern three distinct but overlapping logics of experimentation (Table 1.2).

Table 1.2 Distinct logics of experimentation (Adapted from Ansell and Bartenberger, 2016)

	Controlled experimentation	**Darwinian experimentation**	**Generative experimentation**
Intention	Search for valid inferences about cause and effect	Identification of best-practice through variation and trial and error	Iterative refinement of prototype with goal of 'success', aimed at discovery and design of new solutions
Form of inference	Deductive	Inductive	Abductive
Allowance for failure	High (researcher should not influence outcome)	Very high (few variations are successful)	Low (researchers strive for success)
Innovation vs routine	Both	Both	Innovation
Observational vs interventional	Intervention at the beginning, monitoring thereafter	More observational than interventional	Continuous improvement of intervention
Examples	Randomised control trials (RCTs), natural and quasi-natural experiments	Parallel experimentation and benchmarking, rapid experimentation, simulation experiments	Design experiments, exploratory pilot projects, problem-driven iterative adaptation

There is a crucial difference in how these approaches deal with sequences of experiments. The Darwinian approach tends to assume a higher degree of natural variation, in experiments happening 'out there', whereas the generative approach concerns an intentional and guided iterative processes of designing a solution. They thus assume different focal points. One such generative sequence may well be a part of the 'population of experiments' in a wider Darwinian approach (e.g. one firms series of prototypes of electric cars in the emerging niche of electric mobility).

The Darwinian logic expands what counts as experimental, suggesting that it may not be the result of an intentional intervention, but a project or initiative carried out by others that nevertheless allow for observations to be made and for learning to happen.

Outlining these logics helps put in perspective the kinds of experimentation which have thus far interested transition scholars. Despite its prominence in other domains of social policy, the notion of controlled experimentation has not been very salient in the practice and literature of urban experimentation. SNM scholars have tended to emphasise the Darwinian Experimentation, whereas transition management has been more closely associated with Generative Experimentation, but in effect logics are intertwined.

However, the notion of urban experimentation tries to encompass the activities that is actually going in cities, which probably lies in between these spaces, and which in many cases are not even explicitly labelled as experimental. Juxtaposing the uses and logics of experimentalism identified by Ansell and Bartenberger (2016) provides a useful first step to locate the forms of experimentation which are most salient in debates on (urban) sustainability transitions and for this thesis.

Highlining specific experiments and thinking of them as bounded in time and space, does not do justice to what is happening in many cities, where a multiplicity of experiments is being continually made and remade, and in which experimentation is becoming a central feature of how climate change and other wicked socio-technical-environmental issues are being dealt with.

Loci[3] of experimentation

What then are the loci, i.e. the spaces or settings, in which urban experimentation are thought to be occurring?

Much of the recent research has attended to two fronts, either studying laboratories in various guises (Bulkeley et al., 2015a, 2016; Evans et al., 2015; Evans and Karvonen, 2011; Marvin et al., 2018; Voytenko et al., 2016) or in the urban application of transition management for co-creating transition arenas and studying initiatives that can be understood as transition experiments or transition initiatives (Ehnert et al., 2018a; Frantzeskaki and Kabisch, 2015; Hölscher et al., 2017; Nevens et al., 2013; Nevens and Roorda, 2014; Roorda et al., 2014). This surge of interest in these areas has been shaped, at least in part, by many large European projects in the area.

A critical observation that is central to this volume, however, is that Urban Living Laboratories and other designated spaces for experimentation are but a small part of the wider 'politics of experimentation' (Bulkeley et al., 2015b, 2016; Bulkeley and Castán Broto, 2013; Castán Broto et al., 2013). By privileging the laboratory as the object of study, we are at risk of neglecting more diffuse or organic forms of experimentation, which are not only more prevalent, but which may in effect be central to underpinning laboratories and the development of experiments. Moreover, because the emphasis has been on designated spaces, the research has someone deviated from the aim of having the city as a unit of analysis, and of recognising the multiplicity of experimental forms which co-exist in a place.

Three reasons, thus, lead me to look elsewhere.

First, I concur with the argument by Gross (2016), who recently remarked how in effect:

[3] I refer to this discussion as loci to avoid confusion with place, used to refer to the socio-spacial context (site, situation and sense of place).

> increasingly experimental processes are planned and set up outside the laboratory and that the definition of what constitutes (or even "raises") a laboratory is determined retrospectively—if at all.
>
> (Gross, 2016, p. 614)

According to him, experimental processes 'taking place *in* and *with* society should be considered the normal, or the real-world, experiment' (p.616). His argument is that the traditional sequence from laboratory to real-world has been 'switched around', with the uncertainty and unknowns initially probed through experiments that are later relocated to laboratories. If this hypothesis is right, 'lab experiments are postpositioned microvariants of real-world experiments in and with society' (p.626). That hypothesis also resonates with the perspective of strategic niche management, highlighted earlier, which sees the niche being 'raised' through experimentation, often benefiting initially from 'passive shielding' rather than from a 'active shielding' fully formed (Smith and Raven, 2012).

Second, an emphasis on designated spaces of experimentation tends to emphasise a relatively small selection of the experiments that are likely 'taking place' in a given city. As studies that considered the city as a unit of analysis have shown, there are often dozens or even hundreds of experiments and initiatives occurring in parallel (Ehnert et al., 2018a, 2018b; Schwanen, 2015). The combinations, compositions, and contestations in, between and around these proliferations have been posited as central for understanding the prospects of reconfiguring governance arrangements and socio-technical systems (Hodson et al., 2017).

Thirdly, aiming to address certain priorities designated spaces for experimentation are also (implicitly or explicitly) selective in terms of the participants, epistemologies, forms of co-creation, and approaches to experimentation that are included, in ways that not necessarily reflect the wider context in which they are embedded. As Hodson et al. (2018) showed, these laboratories are often established by mainstream institutions and funding bodies that prescribe particular priorities, thus 'conditioning experimentation' and potentially blunting their transformative edge.

> As long as the potential to re-shape conditions is not fully captured, the process of urban experimentation will essentially sustain the status quo. On the other hand, experiments that emerge organically may provide some potential to challenge mainstream urbanisation as so called 'alternative experiments' that propose more radical visions of the future.
>
> (Hodson et al., 2018)

Therefore, *in this thesis I will attempt to refocus attention on the urban context, stepping back from a focus on singular experiments or on designated experimental spaces, and adopt an open stance towards what counts as experimental.* With that in mind, a critical gap that becomes apparent when reviewing this literature, however, is why some cities seem to be sustaining high levels of experimentation even without laboratories? Put differently, *how cities develop favourable environments which can sustain organic forms of experimentation over long periods of time?*

But given this interest in more diffuse forms of experimentation that is emerging, it is important to question how such efforts actually contribute to fostering systemic change in cities. For that, later in this document, I will seek to bridge the discussion with efforts to characterise the development of urban transformative capacity.

1.3 Towards a place-based perspective

To sum up, as the notion of the Anthropocene highlights, societies are facing a multitude of synchronous, intersecting and mutually reinforcing socio-ecological-technological challenges. Cities are critical to this era, but in contradictory and indeterminate ways. They could, nevertheless, potentially enable a variety of pathways for such transitions or transformations.

Urban experimentation already contributes to these efforts in multiple ways, which has inspired a burgeoning literature. Nevertheless, this emerging body of work remains scattered and unbalanced, overemphasising certain forms of experimentation at the expense of other purposes, logics and loci of experimentation. It is crucial to examine the 'organic' experimentation that is

actually happening in cities - outside laboratories and other designated spaces for experimentation - to understand how particular cities can sustain experimentation and develop the capacities to enact transformations.

A place-based perspective, that gives accent to the interests and visions articulated by coalitions of actors acting in a particular place (i.e. in a historically and spatially situated socio-material context, to which actors attach meaning), and which engages with the wider variety of experiments arising there in a contextually-sensitive manner, is in order.

The primary concern of this thesis is thus understanding what sustains experimentation in particular places, for which I propose to engage provisionally with the notion of *'favourable environments for experimentation'* rather than niches, protective spaces, laboratories, or places. This notion is preferable here for three reasons.

First, it opens to the possibility that multiple distinct dynamics contribute to creating favourable conditions that enable experimentation, rather than a priori assuming they are associated with protection (hence favourable rather than protective). This turns the question of 'how is protection achieved' or 'how did the niche develop' into a more encompassing 'what dynamics enable and sustain experimentation in this particular environment?'

Second, referring to them as environments, rather than spaces, stresses that they are populated by an ecology of different experiments, projects and people, in constant interaction, rather than seemingly empty. It alludes to the notion of an 'ecology of knowledges', which have rich knowledge substrates that interact and serve as inputs for one another (Cohendet et al., 2010). It implies different kinds of environments (similar to the notion of habitats, proposed by van den Heiligenberg et al., 2017), that are situated and specific to places, rather than a generic space. It makes clear that these are hard to design, plan or construct, as they depend on a multitude of processes that co-evolve.

Third, by not conflating environments and places, it becomes clear that these environments may change over time, wax and wane, change directions. These environments can be assumed to be shaped by the place in which they evolve, but they are more ephemeral, malleable and delicate. These environments may also become temporarily anchored and concentrated in different places within a city (e.g. streets, buildings, neighbourhoods), potentially moving around.

In sum, the notion of favourable environment for experimentation can help expand the boundaries of what experimentation and niches are considered to be, without rejecting the important insights which emerged in strategic niche management. In effect, this notion may help reinforce the focus on the co-evolution of socio-technical dynamics. This notion was crucial to launch the explorations of this thesis in the journey towards developing a place-based perspective.

1.4 Research Questions

Against the background present here, the key objective of this thesis is to contribute to *understanding how cities develop favourable environments which can sustain organic forms of experimentation over long periods of time.* Assuming that this question cannot be addressed in universal terms, given the place-specificity and historical contingency of these processes, this contribution will take the form of an analytical approach that can help researchers and practitioners inquire and reflect about this issue.

As the research strategy section and the discussion chapter will show, these research questions are also the outcome of the research process. Nevertheless, presenting them here help us understand the impetus behind the three papers and their contributions.

RQ 1 *How can the long-term evolution of favourable environments for urban experimentation be studied?*

This question will be dealt with in three aspects: how to unpack their history, how to think about the dynamics of their formation, and how to think about their links

to the development of transformative capacity. Addressing this question, I will propose a contextual perspective on urban experimentation, which he discussion will further clarify the difference between 'place-based' approaches and other modes of inquiry which are possible within the transition's community.

RQ 2 *In what ways does the extant literature conceive of contexts for urban experimentation?*

RQ 3 *What dynamics are thought to be relevant in their evolution?*

These questions guided the development of the second paper. It aims at taking stock of what has already been noted as potentially relevant contextual dynamics (self-reinforcing processes between experiments and context) within the transition's literature and the urban experimentation literature.

RQ 4 *How does the formation of favourable environments for experimentation contribute to the development of urban transformative capacities?*

This question speaks to the importance of organic and diffuse forms of experimentation to the development of transformative capacities. Rather than emphasising the insertion of particular experiments through scaling, it emphasises the mobilisation of wider environments, and the challenges of doing so. It will contribute to thinking about how sustaining experimentation contributes to the generation and retention of urban transformative capacities.

RQ 5 *How did a favourable environment for civic energy experimentation emerge in Bristol?*

RQ 6 *How did a favourable environment for civic mobility experimentation emerge in Medellín?*

RQ 7 *How were those favourable environments mobilised in reconfiguring their cities?*

These three empirical questions guided the case studies in Bristol and Medellín.

Table 1.3 shows how the sections of this document covert the research questions.

1.5 Structure of this document

This remainder of this thesis comprises a chapter regarding the overarching methodological approach, three articles, and a synthetic discussion.

Paper 1: **Torrens, J.**, Johnstone, P., Schot, J., 2018. Unpacking the Formation of Favourable Environments for Urban Experimentation: The Case of the Bristol Energy Scene. *Sustainability* 10, 879. https://doi.org/10.3390/su10030879

Paper 2: **Torrens, J.**, Schot, J., Raven, R., Johnstone, P., 2019 . Seedbeds, harbours and battlegrounds: on the origins of favourable environments for urban experimentation with sustainability. *Environmental Innovation and Societal Transitions* 31, 211–232. https://doi.org/http://dx.doi.org/10.1016/j.asoc.2014.04.024

Paper 3: **Torrens, J.**, n.d. Experimentation and the development of transformative capacity in Medellín. Submitted and under review: *SPRU Working Paper Series*

Table 1.3 Research questions and their coverage in the chapters of this thesis

OVERARCHING RESEARCH QUESTION:

HOW CITIES DEVELOP FAVOURABLE ENVIRONMENTS WHICH CAN SUSTAIN ORGANIC FORMS OF EXPERIMENTATION OVER LONG PERIODS OF TIME IN WAYS THAT CONTRIBUTE TO DEVELOPING URBAN TRANSFORMATIVE CAPACITY

		Papers			Discussion
		1	2	3	
ANALYTICAL CONTRIBUTION					
RQ 1	How can the long-term evolution of favourable environments for urban experimentation be studied?	X	X	X	X
CONCEPTUAL CONTRIBUTIONS					
RQ 2	In what ways does the extant literature conceive of contexts for urban experimentation?		X		
RQ 3	What dynamics are thought to be relevant in their evolution?	X	X	X	
RQ 4	How does the formation of favourable environments for experimentation contribute to the development of urban transformative capacities?			X	
EMPIRICAL CONTRIBUTIONS					
RQ 5	How did a favourable environment for civic energy experimentation emerge in Bristol?	X			
RQ 6	How did a favourable environment for civic mobility experimentation emerge in Medellín?			X	
RQ 7	How were those favourable environments mobilised in reconfiguring their cities?	X	X		

1.6 Academic audience, debates and relevance

This thesis' primary audience is the academic community that is concerned with urban experimentation, urban transformations and the governance of systemic change in cities. These topics interest multiple interdisciplinary fields, but my primary focus is the sustainability transitions field. It is closely related to the SNM strand, with which I share a commitment to understanding the processes that hinder and enable socio-technical change and the forms of experimentation happening 'outside the laboratory'. And second, with the geography of transitions, which has questioned how and why transition processes unfold unevenly across space.

More specifically, my research relates to three debates in that academic community. First, regarding why transitions processes are more likely to 'take place' in particular cities. Second, regarding the processes and dynamics which modulate experimentation and its uptake (in general and in particular places). Thirdly, regarding the prospects for the development of urban transformative capacity. The overlaps between these debates has received limited systematic treatment. Where necessary, I will draw from influences further afield to enrich those debates.

A secondary audience of this thesis is the community of practitioners and researchers concerned with the change processes specific to Bristol and Medellín. Both cities have a rich history of studies about governance, innovation, planning, and so forth, from which I drew extensively. In Bristol, I relate closely to the debates concerning the vibrancy of the local civil society (Amin et al., 2002; Barnes, 2015; Bird et al., 2013; Bird and Barnes, 2014; Brownlee, 2011; O'Doherty et al., 1999; Purdue et al., 1997) and the local government engagement with sustainability (Coombes and Fodor, 1997; Emelianoff and Mor, 2013; Gouldson and Millward-Hopkings, 2015). In Medellín, I draw from the wider debates about the unfolding transformation of the city (Bahl, 2012; Hylton, 2007; Maclean, 2014, 2015a; Simmons et al., 2018). In both cases, the experimental perspective which I adopt has been somewhat underplayed in those discussions despite good evidence of its relevance.

This thesis may also be relevant to those concerned with the practice of Transformative Innovation Policy. I have noticed first hand that there is increasing appetite among that community for experimental approaches and curiosity about the role of place in supporting broader transformations.

1.7 Thesis overview

In this thesis, I explore the formation of favourable environments for experimentation, and how they can be mobilised for supporting the development of urban transformative capacity, with the intention of contributing to the scholarship and practice on urban transitions. That is an entry point into the

question of how urban experimentation can be sustained in particular places, which matters because urban experimentalism is increasingly central to the response to multiple local and global socio-technical-environmental challenges.

I argue that in order to mobilise these favourable environments for sustainability, we need to better understand how they evolve. Experiments are ubiquitous, but few places concentrate a multiplicity of experiments and can sustain them for long periods. Close analysis shows that in these places, recursive contextual dynamics link experiments and context: the experiments help to shape the context, which in turn favours experimentation. We seek to develop awareness of these contextual dynamics, to facilitate a reflexive practice that consider how the formation of such environments contributes to developing urban transformative capacity. A variety of tools may be of relevance, but they need to be adapted to a particular place (site, situation and sense-of-place) if they are to be effective. An excessive focus on creating laboratories, as designated environments for experimentation, is not sufficient and may, in fact, divert attention from more tacit, organic forms of experimentation which are already prevalent. The literature on sustainability transitions already has elements that support a more nuanced understanding of these processes, but a pluralistic understanding of the nature of urban contexts may reveal distinct pathways for sustainability transitions.

2 RESEARCH STRATEGY AND METHODOLOGY

Empirical research and theorising are intrinsically connected, yet, that connection is often left implicit or dealt with through convention. Research on systemic change and cities still suffers from 'terminological variety, epistemological disjunctions and blind spots that lack both recognition and reflection in order to inform future strategies.' (Wolfram et al., 2017, p. 18). These characteristics are in part a reflection of the shear variety of approaches that emerged to address urban sustainability challenges. But they are also reflect the 'pluralistic and messy character of the sustainability problem [which] by necessity demands approaches that incorporate precisely these features' (Wolfram et al., 2017, p. 18).

The epistemological diversity is matched by methodological diversity. The rapid expansion of the literature has generated an enormous variety of approaches with which to think about urban experimentation, which define, catalogue, survey and typify experiments and laboratories and map the myriad factors that are thought to either support or hinder experimentation. There have been equally diverse comparative approaches. This includes the following:

- Case studies of specific experiments or grassroots initiatives, set against the background of places (Barnes, 2015; Hielscher et al., 2012; Ornetzeder and Rohracher, 2013)
- Global or regional surveys of experiments (Bulkeley et al., 2015b; Castán Broto and Bulkeley, 2013), laboratories (Voytenko et al., 2016), or grassroots initiatives (Seyfang et al., 2014; Seyfang and Longhurst, 2013)
- Case studies of particular cities cataloguing a multiplicity of experiments as a snapshot (Ehnert et al., 2018a; Raven et al., 2017b; Schwanen, 2015; van den Heiligenberg et al., 2017)
- Case studies of experiments with multiple instances in different places in a city (Håkansson, 2018, 2019)
- Case studies tracing experiments as they travel across multiple places (Carvalho and Lazzerini, 2018; Fontes et al., 2016; Sengers and Raven, 2015)

- Case studies of particular places, focusing on the development of transformative capacity, as snapshots (Brodnik and Brown, 2018; Castán Broto et al., 2018; Wolfram, 2018b)
- Studies about the place-specific enabling and constraining factors (Feola and Nunes, 2014; Hansen and Coenen, 2015; Sekulova et al., 2017).
- Longitudinal case studies around place-based environments for experimentation that attend to the multiplicity of experiments taking place (Longhurst, 2013, 2015)

Of great interest for this thesis, however, are that final category, given our interest on the process of formation of favourable environments for experimentation. The approach put forward in Longhurst's (2013, 2015) analyses of the formation of an 'alternative milieu' in Totness are the closest to the objectives of this thesis. In those studies, Longhurst adopted a 'multimethod case study with a strong ethnographic core'. Given the interest in studying two cities in this thesis, that ethnographic element was not an option. Instead, I look further afield, to clarify the ontological assumptions, logic of inference and the strategy of sense making used for the case studies.

2.1 Critical realism and abduction

This thesis draws lightly on the critical realism as a set of ontological assumptions, which help to clarify the possibility of this research. Critical realism[4], as a philosophy of science, has been powerful in questioning entrenched dualities that have pervaded methodological debates in social sciences, between positivism and hermeneutics, quantitative method and qualitative method, and universalism vs particularisms. These dualisms are not only misleading but strongly aligned (Sayer, 1992). In the practice of social sciences, it is relevant to consider ontology[5], or that which is assumed to exist, because as Archer observes 'it regulates the explanatory

[4] Critical realism is not a homogenous body of work. What I present here draws more closely from the central tenets which are largely accepted in their midst.
[5] In transition studies, 'ontologies' are sometimes understood as the postulation of certain causal agent and primary causal mechanisms that are taken a priori and thus underexamined.

programme that's advanced from within the context of what is held to exist socially.' (Archer et al., 1999).

In our context, critical realism can be best understood as a reaction against two positions (Danermark et al., 2002; Sayer, 1992). On the one hand, it rallies against a naïve realism (empiricism), which takes reality as that which can be observed through 'objective' or 'neural' empirical methods. On the other, it rallies against an extreme relativistic position, which doubts the existence of an objective reality because all knowledge is filtered through language and concepts that are neither fixed nor universal. Hence, a critical realist position assumes that there is a reality that independent of our observation (a realist position), that science and other practices offer possibilities to acquire more or less truthful knowledge about reality, but that the practice of science is always mediated through existing theories where:

> Characteristic of reality is the condition that there is an *ontological gap* between what we experience and understand, what really happens, and – most important – the deep dimension where the mechanisms are which produce the events. Scientific observations and theories are thus always concept-dependent but not concept-determined.
>
> (Danermark et al., 2002)

Critical realist inflects research with a concern for developing better understandings about these deeper mechanisms, thought to produce observable reality, in ways that avoid the misgivings of empiricism (positivism) or relativism (interpretivism). Thus, theory plays a particular role within this approach:

> 1.'Theory is a language, indispensable to science (see Chapter 2).
>
> 2. The theoretical language always includes an interpretation of the social reality. We see and understand the world with the help of theories. Theories here serve as an interpretative framework.
>
> 3. Theories are indispensable when it comes to explanation, since they conceptualise causal mechanisms.
>
> 4. Theories are abstractions; they describe phenomena with reference to certain aspects, which have been separated from other aspects also characterising concrete events or phenomena…

(Danermark et al., 2002)

Crucially, in this understanding, what is sought after is not 'generality' as in terms of the ability to predict a repeated series of events. Instead, the focus is on the 'discovery of necessity', on 'determining the nature of things or structures, discovering which characteristics are necessary consequences of their being those kinds of objects' (Sayer, 1989, p. 258).

In this thesis, critical realism provides a basis for reflecting on the processes and analytical tools which to identify plausible mechanisms which support sustained experimentation. In particular, the approach taken in this thesis can be understood as a form of abduction, one of two modes of inference favoured by critical realism[6]. For critical realists, abduction is a thought operation that seeks:

> To interpret and recontextualise individual phenomena within a conceptual framework or a set of ideas. To be able to understand something in a new way by observing and interpreting this something in a new conceptual framework.
>
> (Danermark et al., 2002)

The key contribution of treating this research as an abductive exercise is that it helps to guide the interpretive processes of making sense of the case studies, and of the literature review. In working towards supporting the identification of the mechanisms that sustain experimentation, I make provisory use the notion of 'favourable environments for experimentation' and 'contextual dynamics' to mediate the engagement with empirical work, and in doing so, seek to interpret the events in Bristol and Medellín under a new light.

Crucially, where deduction demands of researchers logical reasoning (and sound laws to deduce from), and induction demands statistical analysis of regularities (and appropriate data to infer from), abduction relies more directly on creativity and associative thinking (Danermark et al., 2002; Dubois and Gadde, 2002, 2014).

[6] Aside abduction, retroduction is also central to critical realism, because it seeks to abstract away accidental circumstances to arrive at provisory explanations of general mechanisms

> Besides comprehensive knowledge of established alternative theories, models and frames of interpretation, abduction requires a creative reasoning process enabling the researcher to discern relations and connections not evident or obvious –to formulate new ideas about the interconnection of phenomena, to think about something in a different context, an ability to 'see something as something else'
>
> (Danermark et al., 2002)

A central issue of abduction is thus the lack of a priori criteria to 'check' the validity of an abductive conclusion (Danermark et al., 2002; Dubois and Gadde, 2002, 2014). In this regard, critical realism places emphasis on publicly discussing claims about reality, to comparatively evaluate arguments, and settle on 'reasoned, though provisional, judgements about reality really is objectively like; about what belongs to that reality and what does not' (Archer et al. 2004, p.2, cited in Easton, 2010).

It is thus particularly important to present not only the outcome of the research but also to reflect on the process through which those judgements are arrived at. To guide the conduct of abductive case studies, I draw on work by methodologists from the field of organisational studies (Dubois and Gadde, 2002, 2014; Poole et al., 2000; Van de Ven and Poole, 1990; van de Ven and Poole, 2005).

In particular, in both papers 1 and 3, I employed the method of 'systematic combining' articulated by Dubois and Gadde (2002, 2014). This approach builds on abductive reasoning, making the research process more explicit. Systematic combining places emphasis on the intertwined nature of the activities of case study research, as opposed to conceptualising them as a sequence of phases (e.g. literature review, followed by case-selection, etc.). Both the analytical framework and the case definition are seen as evolving throughout the research.

> The preliminary analytical framework consists of articulated 'preconceptions'. Over time, it is developed according to what is discovered through the empirical fieldwork, as well as through analysis and interpretation. This stems from the fact that theory cannot be understood without empirical observation and vice versa. The evolving framework directs the search for empirical data. Empirical observations might result in identification of unanticipated yet related issues that may be further explored in interviews or by other means of data collection. This might bring about a further need to redirect the current theoretical framework through expansion or change of the theoretical model.
>
> (Dubois and Gadde, 2002, p. 555)

Hence, systematic combining consists of two 'confrontations': between the wider empirical world and the theory or theories which supposedly represent it, and between an evolving framework and evolving case.

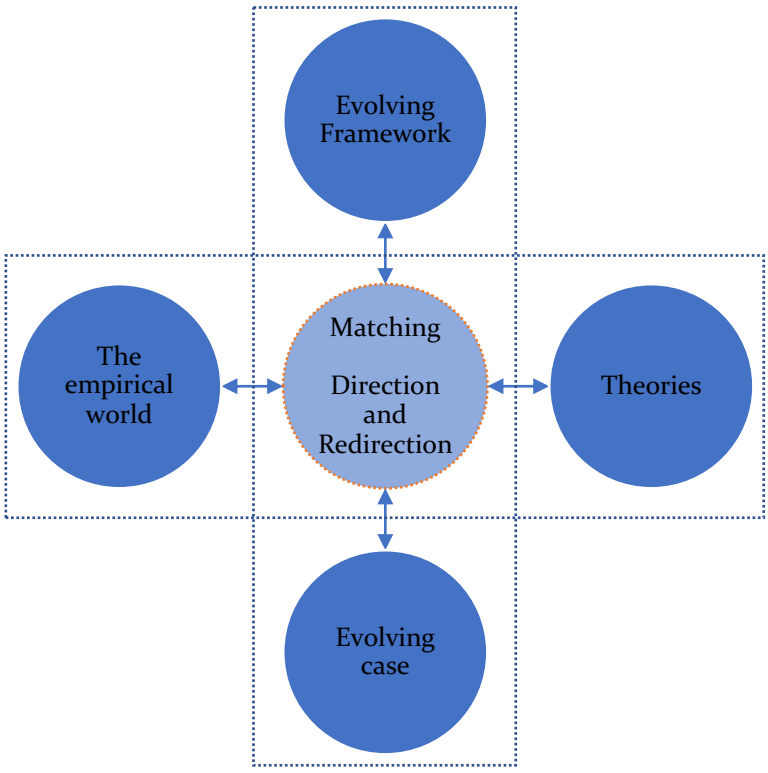

Figure 2.1 Intertwined research activities involved in the 'systematic combining' approach to case-study research (Adapted from Dubois and Gadde, 2002)

Thus, systematic combining is distinctive from more traditional references that propose case-studies should be used as a means to test specific hypothesis deduced from theory, or that emphasise multi-case analysis informed by a logic of replication (e.g. Eisenhardt, 1989; Yin, 2014).

In particular, systematic combining challenges the notion that a case is selected and delineated a priori and that all relevant theory can be known in advance. Instead, the boundaries of the case and the focal interest may change as a result of the attempts to match theories and empirical observations. And other theoretical perspectives may be mobilised, as further relevant empirical observations arise. Hence, both the framework and the case are seen as evolving until the moment the research is finalised, and a good match between them is found.

In this sense, Dubois and Gadde (2002) present case and framework as both *tools* and *products* of the research effort, which need to be 'sharpened' during the research and which need to be finalised with an intentional effort to sort out the and decide which pieces of empirical evidence are left in and left out.

This method will be discussed in further detail in the first and third papers. The emphasis on the abductive nature of this method demands engagement with concepts as part of an 'evolving framework'. In this thesis, the first paper introduces a preliminary framework which launched the research, and which was the object of the first round of matching and redirection. The overall abductive research journey is subject to a more extended reflection in section 6.1 (p.215), which reviews the multiple 'redirections' and 'matchings', through which the conceptual and analytical focus of the research was iteratively sharpened. Meanwhile, the following section foreshadows important dilemmas encountered in this effort which could not be dealt with in detail in the papers.

2.2 Conceptual challenges and key concepts to study favourable environments for experimentation

In this thesis, adopting an abductive stance outlined above led me to encounter four pressing conceptual challenges and associated methodological issues. The papers that follow discuss in detail on the conceptual development which resulted, introducing these core concepts gradually, jointly with the reflections that led to their refinement. In each paper, I present a discussion of the current debates surrounding these concepts, and of the methodological dilemmas that ensue.

The analytical approach which resulted from addressing these challenges and methodological questions is the main outcome of this thesis. The table below summarises the key challenges, which will be discussed in detail in the synthesis section.

Table 2.1 Conceptual challenges and methodological dilemmas faced in this thesis

Conceptual challenge	**Core concept developed in the thesis**	**Methodological issues**	**Analytical approach adopted**	**Location of detailed discussion**
Determining the aspects, relationships or dynamics which matter in sustaining experimentation overtime, in particular places	Favourable environment for experimentation (building on notion of context as developed by different schools of thought)	What to include and what to exclude ? How to synthesise distinct accounts about context? What role for researcher in construing an account of 'the context'?	Abductive case study using systematic combining, with triangulation between interviews, visits, and re-interpretation of multiple case-studies	Papers 1 & 3
Describing how the environment for experimentation changes overtime, considering both periods of relative stability and periods of change	Settlements (building on similar notions from strategic action fields and multi-level governance)	How to identify (un)stable periods? How to determine what instigates change?	Careful observation and triangulation of the exogenous phenomena leading to reorganisation of governance arrangements or repositioning of experimentation	Paper 1
Understanding the relationships between experimentation and its environment, despite plurality of conceptual approaches	Contextual dynamics (building on observations about context from different schools of thought)	How to deal with plurality of theoretical approaches that treat context with diverse nomenclatures, metaphors and paradigms	Combination of Problematisation* and Critical Interpretive Synthesis*	Paper 2
Understanding how sustained experimentation influences ability of stakeholders to engage in urban transformations	Urban transformative capacity (building UTC framework)	How to determine which aspects of capacity development are relevant at different stages?	Similar to first challenge, with added emphasis to 'signposting' in the case narrative the instances of factors highlighted by the UTC framework	Paper 3 and Appendix D

* Method detailed in the paper

2.2.1 Context and contextualising

> Context is that which environs the object of our interest and helps by its relevance to explain it. The environing may be temporal, geographical, cultural, cognitive, emotional — of any sort at all. Synonyms for context, each with its own associations, are words such as environment, milieu, setting, and background.
>
> (Scharfstein, 1989a, p. 1)

In this thesis, the notion of context in the contemporary usage[7] mentioned above is central. In particular, I apply this notion to consider the relationship between urban experimentation and the urban settings in which it arises.

Context, in its many guises, and the effort of contextualising, are central to my analytical strategy. As discussed by Dilley (1999), contextualising presents a counterpoint to either internalist/essentialist accounts (which attribute the characteristics of the object or phenomenon of interest to its own internal constitution) or universalist accounts (which attribute the emergence of phenomena exclusively to the combination of general laws, principles or mechanisms). Arguing for (more) contextually-sensitive accounts is to insist on considering that the phenomenon in question is partially caused (or influenced in its expression) by its embeddedness in and connections to that environ. And it challenges implicit assumptions about a homogenous background in which phenomena everywhere can be studied in the same way (Scharfstein, 1989a).

When contextualising, researchers could potentially 'look for context' in many places or sets of relationships. The notion of setting or surroundings is by no means restricted to the immediate vicinity of the object. Instead, theories often present classificatory schemes or heuristics which highlight distinct these sets of relationships, foregrounding some and backgrounding and even neglecting others. Theorising and contextualising are thus intertwined, generating provisory claims

[7] Scharfstein (1989a) and Dilley (1999) also discuss in depth the usage of context in linguistics, concerning the weaving of words to generate meaning.

about what events, objects, actors are relevant (and therefore included in the context) and those that aren't, and specifying the dynamics involved.

On the one hand, this means that even slight shifts in how the object of study is framed (e.g. focusing on sustained experimentation instead of specific labs) implies a reassessment of the context. On the other, it suggests that particular schools of thought may take for granted what constitutes the context. When the latter is true, their concepts and heuristics may become a hindrance for research.

A thorough and methodologically consistent approach for investigating the context is called for but also mired with difficulties, as many theorists have argued (e.g. Asdal and Moser, 2012; Dilley, 1999; Scharfstein, 1989a).

A central dilemma faced by any attempt to theorising is **how to discern between relevant and irrelevant aspects of the world, as to compose a sufficiently rich account of what is happening without getting lost in the process**. Researchers always have to contend with the natural unboundedness of the concrete realities in which the phenomena of interest are embedded.

> (…) if we do not limit it either intuitively or arbitrarily, [context] it is unrestrained by any natural limit of its on (…) we discover that context extends so far, from the most encompassing framework of experience to the most minute particles (or waves), that we can never finish with it. We discover that it always remains possible, and in some perspective true, that our understanding has been limited because we have not paid enough attention to context.
>
> (Scharfstein, 1989b, pp. 59–60).

Instead of expecting a comprehensive, definitive and generic method to 'deal with the context', it would seem we have instead to contend with partial, provisional and situated approaches. As Dilley (2009) points out, attempts at establishing the context of a given object or phenomena of interest create both connections and disconnections, inclusions and exclusions.

> A phenomena is connected to its surroundings: contexts are sets of connections construed as relevant to someone, to something or to a particular problem, and this process yields an explanation, a sense, an interpretation for the object so connected. The context or frame also creates a disjunction between the object of interest and its surroundings on one hand, and those features which are excluded and deemed irrelevant on the other.
>
> (Dilley, 1999, p. 2)

Importantly, when researchers are implicated in studying and portraying context, they don't engage in this processes from neutral, a-theoretical standpoints, and thus don't generate 'neutral observations' about what those aspects may be. Instead, both their observations and their interpretations are theory-laden, as critical realists would argue (Danermark et al., 2002; Sayer, 1992). Even theories which don't explicitly use context as a concept have to delineate their objects of study and delimit the scope of empirical investigation, and always do so 'from somewhere', adopting particular entry points into the research, and limits to how far they are willing or capable to go on 'tracing' the relationships that form the context.

Furthermore, as feminist critiques of the science and technology studies field have pointed out, it is particularly problematic when attempts to contextualise phenomena lack reflexivity about what is made visible and invisible, and 'whose versions of whose worlds one chose to start from and make central in tracing realities in the making' (Asdal and Moser, 2012, p. 303).

A first element to cultivate such reflexivity is to consider the plurality of theoretical approaches to context and their methodological implications. A second element regards a closer examination of the process of research as a situated practice, carried out by researchers who are not exempt from constraints and interests, and where researchers make myriad decisions about what counts or not as part of the context in their accounts. The paragraphs that follow illustrate this first element, while section 6.1 (p. 215) returns to the second.

Some theories rely on specific analytical categories to sort through the multiple dimensions of possible observations. The MLP for example, argues for a nested

relationship between various 'environments', with niches embedded in regimes, and regimes embedded in landscapes, each of these contexts with particular dynamics associated with them (Grin et al., 2010). That perspective affords explanatory power to interactions between and within levels (e.g. niche internal processes, niche-regime interactions, regime-landscape interactions). As discussed earlier, the MLP was not developed with urban experimentation in mind, and the adaptation to urban settings is not trivial. Precisely what counts as a niche, in this theory, is also object to substantial debate and an has to be dealt empirically; the analysts brings to bear a degree of tacit knowledge which is hard to codify.

Other theories underline the importance of ethnographic methods for tracing which heterogeneous elements have been involved in the phenomena in question, and refute the use of hierarchies and strata to deal with the complexity of the world (see Asdal and Moser, 2012). Actor-network theory is a prime example, with its proponents seeking to deal away with reified notions of context and instead arguing in favour of 'following the actors' as a way of establishing which relationships are effectual in a given phenomenon.

> The actor-network theory point is that realities are not given but constantly enacted and coming into being. Actors and events add to what is already there and cannot be reduced to an explained by some presumed, so-called outside forces that are thought to determine them.
>
> (Asdal and Moser, 2012, p. 293)

In a classic example of this perspective, Law and Callon (1992) studied in considerable detail the failure of an aircraft project, illustrating how the actors involved in the project had to mobilise both a local and a global network of other actors, resources and designs, while seeking to negotiate the interactions between the two. Those actors, were, in this sense, constructing and maintaining 'the context' in which they were operating. However, actor-network theorists would avoid adopting context as a concept, preferring to use the term network to express more explicitly the relational, heterogeneous, extensive and sprawling aspects of that which environs their interests.

Other theories still present general principles around which contexts are thought to form and behave, but don't specify classificatory schemes to sort through different aspects of the context. Here, we can list field theories such as Bourdieu's - mobilised by Hoffman (2018) to discuss the politics of experimentation - or the Strategic Action Fields theorisations (Fligstein, 2008; Fligstein and McAdam, 2011, 2012). As Hoffman puts concisely,

> The field concept helps us unravel the relational dynamics underlying observable interactions between actors, which become manifest upon crises and surprises in the emergence of new practices. From this perspective, individuals, communities, and organizations in a context are not seen as isolated entities, but as being located in practices and categories of perceptions that have evolved in relation to each other. From the different positions occupied in a field, actors may respond to each other's actions and reorient their own actions accordingly. This implies that actors in action co-create the context of their actions and in doing so trigger tensions and possibilities into being that would otherwise have remained invisible. As such, the field concept helps us conceptualize how contexts come into being and how actors actively take positions in shaping their environment.
>
> (Hoffman, 2013, p. 12)

Actors, in this sense, are not merely embedded in contexts which they cannot understand or observe, but instead are seen as active participants in reading, shaping and to some extent asserting control of their surroundings, displaying different degrees of 'social skill' in doing so (Fligstein and McAdam, 2011).

This plurality of theoretical perspectives about what counts as the context, therefore, is further complicated by the fact that actors that take part in the research are themselves construing contexts, i.e., reflecting on the conditions, events, and interests were salient, and crafting explanations and strategies based on those observations.

Within the literature dealing specifically with urban experimentation, as the second paper will show (Chapter 4, p. 127), there have been studies treating the contexts of experimentation along each of these lines, which have been generative

in revealing distinct aspects of the processes involved in sustaining experimentation.

In the case studies I carried out for this thesis, the interviewees themselves had been implicated in weaving together and stabilising the environments which supported experimentation and shaping the discourses about it. They were, in this sense, knowledgeable and interested in the history and effects of the environments which they helped shape. In Bristol, as we will see, it was not uncommon for actors and researchers to refer to notions such as the city's 'green milieu', 'alternative milieu', and 'energy scene'. And in both Bristol and Medellín, there were active efforts to portray the city as a 'laboratory' for experimentation, matched by efforts to contest and reframe those assertions.

In this sense, through the memory and active participation of stakeholders, we can expect that (past and current) experiments are implicated in creating contexts for future experiments. Their results, expectations, disappointments, partnerships, and how successful or not they are perceived to be, can be used by actors in to mobilise resources, establish and stabilised networks (Law and Callon, 1992).

That raised a second dilemma about the multiplicity of context: **to what extent is there a shared environment in which actors partake, given their unique perspectives and understandings of what is or is not salient, and their own interests in construing narratives about those environments?** Moreover, if such an environment is thought to exist, how can it be studied?

From early on in the project, two approaches to this dilemma stood out. The literature on strategic niche management suggested that intermediary and niche actors were central in creating a sense of shared understandings and negotiating the protection for experimentation, thus establishing the contextual conditions for experimentation to flourish.

Meanwhile, the position proposed by Fligtstein and McAdam argued that the interaction between actors gives rises to an emergent 'field of strategic action' in which it is possible to distinguish routinised forms of action and framings of what

is at stake (and hence of what is relevant), and a sense of what is allowed or not. Actors may come to challenge those narratives and construe alternative propositions, but they do so acknowledging the collective and rules which they perceive others to take. This also suggests the possibility of studying that shared, emergent field of action through the study of the actors' particular perspectives, but understanding them as motivated rather than unbiased accounts.

To further analyse what this environment may be, the overall analytical stance adopted in this thesis sought to resolve these dilemmas when confronting the empirical reality with the abductive approach (systematic combining, explained in papers 1 and 3). The learning curve which is developed in this thesis is precisely that different perspectives on context, and its relationship with experimentation enrich the analysis.

Empirically, I took this forward by analysing and triangulating between three types of sources. First, I elicited accounts from actors themselves about the conditions, events and participants which shaped their contexts and their initiatives. Interviewing actors steeped in urban experimentation happening in Bristol and Medellín provided access to different accounts about what the environment for experimentation in the city was. Second, I analysed the policy documents which outlined the initiatives carried out by the municipalities themselves, that aimed to consolidate a fragmented landscape of initiatives and experiments, as well as create more stable institutional conditions for their fulfilment. In those policy documents, there were often implicit arguments about the cities' environments for experimentation and attempts to steer those environments in particular directions. Third, I sought after scholarly articles which had grappled with the question of why Bristol and Medellín were considered 'innovative' or 'transformative', written from various perspectives. The latter provided better coverage of the long-term analysis of the cases. Via triangulation, the case studies created an opportunity for taping into the emergent environments for experimentation.

In particular, as discussed in section 1.2.4 (p. 32), we are concerned in this thesis with the neglect of the *urban context* in the debates about sustainability transitions. I am thus particularly interested in whether salient features of the urban setting in which experimentation is being carried out influence and are influenced by experiments.

2.2.2 Settlements: capturing stability and change in contexts

Our interest in understanding the formation of favourable environments for experimentation demanded insights into how they emerge, and whether they are stable and change, and what forms of interactions trigger such change. This discussion is expanded in the first paper, but here I foreshadow the notion of 'settlements', which is derived from both institutionally informed accounts of strategic action fields and in discussions about multi-level governance. Settlements are, for the purposes of this thesis, **periods of relatively stable constellations of actors and prevailing framings of what is at stake, resulting in particular patterns of activity (patterns of experimentation), and modes of governing this activity.**

In the theorisation of strategic action fields (Fligstein and McAdam, 2011, 2012), the notion of *institutional settlement* is used to analyse the stability of particular social activity ('strategic action fields') that are seen as embedded in and in relation with other fields. A field is settled, in this view, when there is a 'generalised sense of order' and 'consensus about the relative positions of incumbents and challengers' (Fligstein and McAdam, 2012, p. 23). This stability is not only dependent on the 'internalised world view' of those in the field but also maintained by the development of a form of internal governance (for example, through intermediaries, a forum, a committee). Agreement about what is at stake does not preclude the jockeying for positions as different actors seek to pursue their interests. Such stability is potentially upset by changes to relationships to other fields (e.g. changes in the regional government affecting the city's efforts), new entrants (e.g. a new municipal energy company which challenges the local energy

cooperatives), and 'macro events' which create a sense of generalised crisis (e.g. the 2008 global financial crisis).

Similar discussions have figured in the literature on Multi-level governance.

> The concept of a local political `settlement' seeks to capture the interaction of national policy and institutional initiatives with existing local economic and political cultures. Particular settlements reflect how previous policies, formulated and introduced from outside the locality, combine with the governing institutional configuration already in place, a configuration which may itself be the outcome of previous policies and politics (…) Conceiving of political relationships in this way allows the (intended and unintended) effects of extra-local decisions to be included in a theorisation of local networks, partnerships, and coalitions.
>
> (Ward, 2000, p. 287)

Both these perspectives place emphasis on the tension between routinised forms of action and the jockeying of positions and negotiation within and across different domains of society. Both highlight how the patterns of activity in a given field (Manchester's marketing strategies, in Ward's case) are inherently exposed to shifts in other levels (shift in government priorities after an election, for example).

Settlements, in the synthetic definition I presented above, serve both as ways of structuring the narrative of a long-term case study, revolving around natural breaking points between different periods of the case, and as a strategy of sensemaking.

As an approach to sensemaking, analysing settlements is equivalent to what Langley (1999) denotes 'temporal bracketing strategy'. As such, they are not assumed to be phases in a predictable sequence, but rather a way of structuring the description of events. The temporal bracketing strategy, in thus useful in so far as:

> It permits the constitution of comparative units of analysis for the exploration and replication of theoretical ideas. This can be especially useful if there is some likelihood that feedback mechanisms, mutual shaping, or multidirectional causality will be incorporated into the theorization. (…) The decomposition of data into successive adjacent periods enables the explicit examination of how actions of one period lead to changes in the context that will affect action in subsequent periods.
>
> (Langley, 1999, p. 703)

The possibility of theorising feedback mechanisms and mutual shaping (co-evolution) is precisely what we seek to examine the evolution of these environments for experimentation, for which we mobilise the notion of contextual dynamics later on (section 4.4.2, p.158).

Adopting the notion of settlements as a temporal bracketing strategy means that 'a shapeless mass of process data' is organised as a series of 'discrete but connected blocks' (Langley, 1999). Within each block, the data describes relatively stable or linearly evolving patterns, while discontinuities demand analysis of a new block. The notion of settlements, as presented above, suggests attention to the relationship to other levels of governance, and adjacent fields, as particularly important in determining the breaking points in the narrative, as moments in which the stability of a given settlement is challenged and opens up the possibility for more profound change in the patterns of experimentation.

One challenge in this analysis is that 'there is no a priori guarantee that discontinuities will allow themselves to produce unequivocal periods' (Langley, 1999, p. 703). In the case studies presented here, I dealt with this issue by being particularly careful in mapping and triangulating the events surrounding the discontinuities and comparing the cases to other studies about those contexts.

As papers 1 and 3 will show, distinctive patterns of experimentation and modes of governing can be distinguished within a settlement, thus providing a way to analyse who they co-evolve, and understand what are the central dynamics implicated in their reproduction.

2.3 Approaching the urban comparatively

The dilemmas regarding context are particularly relevant in the study of urban phenomena and touch at central theoretical debates in urban studies, including the possibility of comparative studies. Briefly reviewing these are relevant here to further clarify how we understand the urban context and the case selection rationale. Theorising urban sustainability transitions is complicated the definitional issues that surround urban, city and place. Urban theory is far from settled on this issue (Brenner and Schmid, 2015; Jacobs, 2012; Scott and Storper, 2015).

On the one hand, the notion of 'planetary urbanisation' has been gaining (theoretical) ground amidst the accelerated urbanisation associated with the Anthropocene (c.f. Brenner and Schmid, 2015). Geographers and political ecologists are pursuing conceptual and cartographic experimentation with an 'urban theory without an outside' (Brenner, 2014). They emphasise the wider circulations of capital, information, and material flows which fuel the 'metabolic' reproduction of this urban process and see the boundaries of the city 'exploded' by the tentacular expansion of urban infrastructure and influence. These explorations have thus been questioning the implicit '*methodological cityism*' of urban research, that departs from the city as an a priori and self-evident entity. Whereas such explorations may indeed open new avenues for engaging with urban-but-planetary (un)sustainability transformations, they far exceed the immediate interest of most studies in urban transitions, which still concern particular cities, however difficult it may be to bind them.

On the other, a more pragmatic reading recognises that cities still have political, regulatory, planning, economic, and identity purchase. In this perspective, there is still value in considering the perspective of cities in grappling with these multiscalar, multidimensional issues. As Pincetl (2017) puts succinctly:

> City change is contingent on political, economic, and social rules, codes, conventions, treaties and other structuring frameworks that exist at multiple, interacting and interdependent scales. It is not that cities are powerless in affecting their own destinies… it simply means that they are constrained, and it is essential to catalogue, measure and describe their structural situation. The degree of constraint will vary from country to country, as will the legal purview of cities. No city is an island, and the limitations imposed by the wider system must be understood for cities to be able to affect not only the direction of climate change, but also to reorganize themselves.
>
> (Pincetl, 2017, p. 5)

Urban transitions would do well, for the moment, to focus on the latter, even if it means it is not at the vanguard of geographical thought. Without reinstating similar points geography of transitions, it is worth reviewing the arguments about scaling, relationality and comparability raised among the comparative urban studies (McCann and Ward, 2010; Nijman, 2007, 2013; Robinson, 2004, 2005, 2011; Ward, 2010). I draw here from primarily from Ward's (2010) synthetic 'relational comparative approach'.

First, Ward (2010) remarks that too often the multi-level governance literature takes scales (i.e. nation, region and city) as fixed entities. Instead, he proposes that scales can be understood as constructed dynamically and politicised, made and remade as the 'contingent outcome of the tensions that exist between structural forces and the practices of human agents' (Marston, 2000, p. 220). The 'scaling' of a particular challenge or responsibility (e.g. climate change) is thus an important political process that should be endogenous to the analysis (Späth and Rohracher, 2014). However, it is concurrent with efforts to build 'horizontal' and heterogeneous networks which are not scalar. Hence, as Bulkeley clarifies:

> governing the environment involves both political processes of scaling and rescaling the objects and agents of governance, as well as attempts to create new, networked, arenas of governance (…) recognition of new 'spatial grammars' is necessary for understanding emerging hybrid forms of environmental governance and their political and ecological implications.
>
> (Bulkeley, 2005, p. 875)

Second, Ward (2010) cautions against treating cities as 'discrete, enclosed and analytically separate objects', as 'bounded and given, self-identifiable'. Instead, he proposes to recognise cities as more open, embedded and relationally constituted. Cities then can be understood as

> (…) both a place (a site or territory) and as a series of unbounded, relatively dis-connected and dispersed, perhaps sprawling activities, made in and through many different kinds of networks stretching far beyond.
>
> (Robinson, 2005, p. 763)

Summarising, Ward (2010) sees the possibility of a *relational comparative* approach that is conducive to a cosmopolitan practice of urban studies (or urban sustainability transitions). Such a cosmopolitan interest looks beyond the cities that for many years captured the imagination of urban studies (e.g. Chicago, London, New York, Los Angeles, Paris). Instead, this approach is:

> (…) drawn to learn from cities from everywhere – from a world of diverse, distinctive cities – and which is not limited to or fixated by the processes and places of the powerful (…) We should be able to appreciate the diversity of processes and activities which go on in specific cities, producing their distinctiveness, as well as the many kinds of connections which are forged (…) beyond neighbourhoods, quarters, municipalities and city-regions (…)
>
> (Robinson, 2005, p. 763)

Such an exercise is particularly relevant, given that cities – most clearly through urban policy practitioners - are already steeped in 'actually existing comparative urbanism' of networks and bilateral collaborations (Clarke, 2012; see also McCann, 2013).

2.3.1 Case selection

In this thesis, the idea of 'studying cities through elsewhere' was combined with the abductive approach described above. Embracing an evolving framework and evolving cases meant that the initial reasoning for case-selection had to be reviewed during the research, as both the cities studied and the focal points shifted. Later, in section 6.1 (p.215), I revise that research journey in detail.

In the first instance, Bristol was selected early on in the project, as part of an initial interest in the dynamics of municipal energy utilities. At the time, the city was being celebrated as a pioneer and an exemplar in Europe and the UK for various aspects of its sustainability policy. However, during a pilot case and first visit to the field, I realised that the municipal energy utility which had brought me there was but a very recent instance of a much longer history of pioneering experimentation with alternative forms of energy provision, and sustainability more broadly. As I continued the research, the empirical focus shifted to understand the emergence of favourable environments for experimentation. In this sense, what I thought initially as a case of municipalisation of energy utilities turned into a case of emergence of a favourable environment for experimentation with civic energy alternatives. As a result, the temporal coverage of the case also shifted, to encompass the period from 1960 to 2015.

While still interested in the role of municipal energy utilities, my attention was drawn to Medellín, a city with an unusual history of municipal utility ownership, which was leveraging its energy company to finance a substantial transformation of the city. As my interest shifted in Bristol, it became clear in that Medellín also had an interesting story of experimentation regarding novel approaches to urbanism and mobility. The city was increasingly understood to be an exemplar of urban transformations, with the local government actively positioning it as a laboratory of urban practices. Hence, despite the redirection, the possibility of studying the long term development of the environment for urban experimentation in Medellín consolidated the central interest of this thesis.

At a first impression, juxtaposing these two cases offered the possibility of examining in more detail the relationship between the efforts of the municipality and that of the grassroots in the development of favourable environments for experimentation. The two cases seemingly represented distinct pathways for the development of a favourable environment for experimentation. The first case in Bristol had shown that relationship to be a central issue, and Medellín appeared to have a peculiar 'municipalist' approach to its urban transformation.

Aside from these considerations, four other tactical decisions played a part in developing these two cases.

Initially, I was also considering the possibility of access (language, initial contacts) and financial constraints of the project. The initial visit to Colombia, through another project, demonstrated that Medellín was not only at the stage of an intriguing process of urban transformation but that I would also benefit from the contacts I established to launch the research there.

Second, as I became more interested in the phenomena of urban experimentation, I decided to de-emphasise the sectoral dimension of the project, for which having cases on both energy and mobility experimentation was of benefit. In particular, Medellín was undergoing a much broader transformation (Simmons et al., 2018), which extended well beyond the mobility regime alone. Previous studies in the city had shown how developments in one domain (e.g. mobility) benefited from and contributed to the broader transformative process.

Furthermore, I was hoping to avoid the tendency to portray examples from Europe as standards for other regions to follow. In juxtaposing a similar phenomenon emerging in a European and a South American city, both with distinct histories and governance structures, I sought to avoid reproducing the bias towards presenting the European experience of sustainability transitions as universal. This was initially implicit but became more relevant as I became familiar with the literature on comparative urbanism (Clarke, 2012; Robinson, 2011; Ward, 2010).

Finally, I was also concerned with not studying cities from the global south exclusively, to avoid being boxed as a 'global south' researcher. Reflecting on the possibility of carrying out research in different global cities, I noted that European researchers rarely had to justify their interests abroad, whilst other researchers had a more difficult time having their research being recognised as a contribution to the research field at large, instead being automatically assumed to be experts in their own contexts.

Hence, following the abductive process of matching and redirection, the object study of this thesis was gradually clarified and characterised, paralleled by discoveries in the early stages of the empirical research, and my development as a scholar. In this sense, the two cases do not form a conventional comparison – seeking to compare similar contexts – but instead, a relational one, in which the kinds of questions I was encountering in one study influenced how I came to think of the other.

As a result of these redirections, the case in Bristol is one that traces the emergence of 'the Bristol Energy Scene', while that in Medellín studying the contribution of urban experimentation (in particular with mobility solutions) in the development of transformative capacity in the city. Section 6.1 (p. 215) reviews this research journey in more detail.

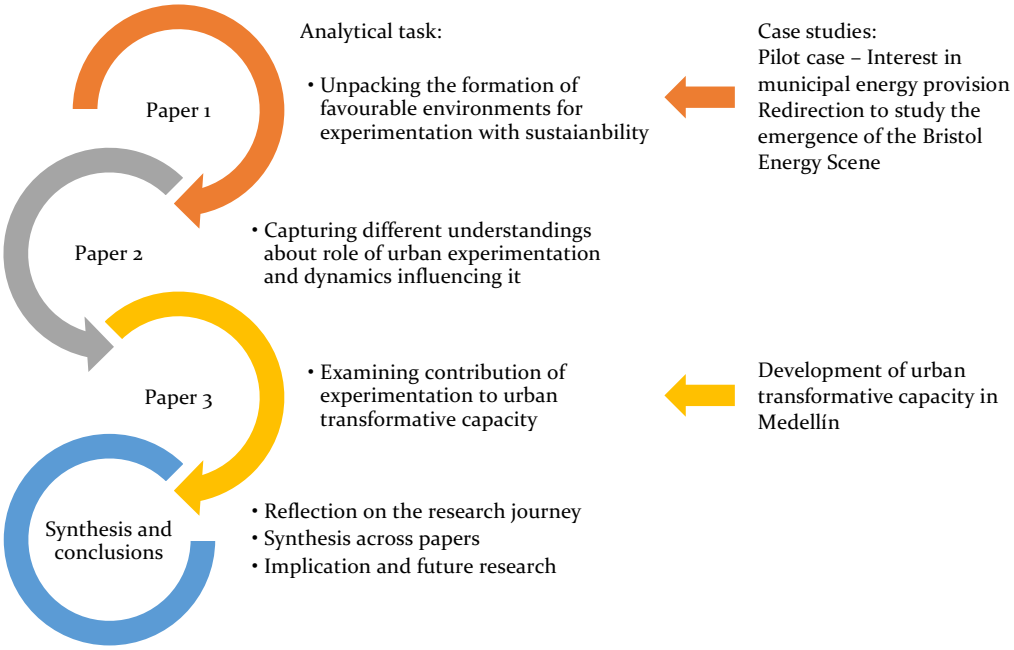

Figure 2.2 Contribution of the case studies to the analytical tasks of this thesis

2.4 Note on the presentation of the papers

The papers that follow have been reproduced with the publisher's permission. The numbering of sections, the formatting and the reference styles were converted to maintain consistency with the rest of the document. The papers' references and appendixes are presented at the end of the document, in a single list.

3 PAPER 1

UNPACKING THE FORMATION OF FAVOURABLE ENVIRONMENTS FOR URBAN EXPERIMENTATION: THE CASE OF THE BRISTOL ENERGY SCENE

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Abstract

Urban experimentation with sustainability has been gaining prominence in policy and academic discourses about urban transformations, spurring the creation of urban living laboratories and transition arenas. However, the academic literature has only begun examining why experimentation flourishes in particular cities, and why it conforms to place-specific styles. Meanwhile, the strategic niche management (SNM) tradition has extensively explored how protective spaces for experimentation emerge but has dealt only tangentially with why this happens in particular places. In this paper, we develop an approach for unpacking the formation of favourable environments for experimentation in specific places. We adopt an abductive research design to create a dialogue between distinct theoretical positions and one in-depth case study. Our case examines the formation of the Bristol energy scene, which hosts a variety of experimental initiatives concerning civic energy alternatives. Based on our findings, we refine the understanding of the processes shaping this experimental setting. There is value in characterising the 'genealogy' of experimental spaces and acknowledging their antecedents, path-dependencies and place-specificities. Efforts to foster urban transformation demand nuanced accounts of how places become experimental because they are not static backgrounds for experimentation.

Keywords: urban experimentation; strategic niche management; urban energy transitions; Bristol; sustainability transitions

3.1 Introduction

Urban experimentation with sustainability has been gaining traction in academic and policy discourses as a way to enable transitions towards more sustainable futures (Bulkeley et al., 2015b; Bulkeley and Castán Broto, 2013; Evans et al., 2016). Urban experiments are being mobilised not merely to study the city but also to probe diverse urban futures, harness innovations to transform the city and its various sociotechnical systems (Edwards and Bulkeley, 2018; Hodson et al., 2017; Schwanen, 2015) and contribute to developing the capacities required for transformation (Wolfram, 2016). Proponents of urban experimentation have devised and implemented a variety of experimental spaces, such as urban living laboratories, transition arenas, platforms, and experimental districts, which are the object of a thriving body of literature (Evans, 2016; Evans and Karvonen, 2014; Farrelly and Brown, 2011; Karvonen and van Heur, 2014; Nevens and Roorda, 2014). While the literature on urban experimentation has emphasised deliberate efforts to construct experimental spaces, the question of how a particular place or city becomes a favourable environment for experimentation with sustainability has hardly been asked. This is the question we explore here.

Scholars in the sustainability transitions field (Markard et al., 2012) have dealt tangentially with the history of experimentation in particular places. Most analyses focus on systemic change at national or international scales, foregrounding emerging technologies while place-specific factors reside in the background. This is also the case for the strategic niche management (SNM) strand of this literature. However, this strand contains insights that are relevant to our question due to its emphasis on niches—spaces that afford temporary protection for experimentation and learning that nourishes path-breaking innovations (Kemp et al., 1998; Schot et al., 1994). Studies have detailed the processes and politics involved in the emergence and deliberate development of such niches (Raven et al., 2016a; Schot and Geels, 2008; Smith and Raven, 2012) and highlighted that local experiments co-evolve with niches that comprise multiple localities (Fontes et al., 2016; Geels and Raven, 2006; Sengers and Raven, 2015; Smith and Raven, 2012). We take SNM

as a starting point to develop a perspective that puts places, rather than socio-technical systems, up front.

Vibrant debates surround the niche concept, but it remains unclear how to operationalise these insights into a place-based approach. There has been much attention to the geography of sustainability transitions (Bridge et al., 2013; Hansen and Coenen, 2015; Truffer et al., 2015), the characteristics of sustainability experiments (Kivimaa et al., 2017; Sengers et al., 2016), and the politics of urban transitions (Bulkeley et al., 2011; Rutherford and Jaglin, 2015; Wolfram and Frantzeskaki, 2016). These studies identify limitations in the current conceptualisation of niche formation and caution against assuming that cities are equivalent to niches. More recently, this literature has begun asking questions concerning how places can be reconfigured by multiple kinds of local experiments (Hodson et al., 2017; Schwanen, 2015; Truffer et al., 2015), why experiments proliferate and flourish in certain places (Feola and Nunes, 2014; Hansen and Coenen, 2015; Longhurst, 2013, 2015), and how situated institutional arrangements shape place-specific styles of experimentation (Raven et al., 2017b; van den Heiligenberg et al., 2017). A place-based perspective would enable research in these areas.

Drawing on these debates, we put forward an approach to understand the emergence of favourable environments for experimentation in a particular city. We argue that it is complementary to existing accounts of niche formation precisely because it shifts attention away from the design and development of niches, towards a focus on the development of a broader place-based environment for urban experimentation. We explore and develop this focus with a case study of Bristol.

If the UK's energy sector had a laboratory for civic alternatives, Bristol would likely be its home. It hosts an exceptional concentration of experiments and policy initiatives signalling a low-carbon energy transition. Grassroots organisations, the local government, skilled intermediaries, and social entrepreneurs are all implicated, in what could be described as an emerging 'energy scene'. This includes

the UK's largest energy cooperative, a new municipal energy company (Bristol Energy), and a myriad of experiments which are broadly oriented around civic goals such as local empowerment, local economic development and sustainability. This level of engagement is atypical in its diversity and persistence, which previous studies attributed to a green and alternative milieu: a localised concentration of green, countercultural movements which sustain a distinctive cultural environment and political orientation with origins in the 1970s (Amin et al., 2002; Brownlee, 2011; O'Doherty et al., 1999; Purdue et al., 1997). These characteristics seem to be reinforced by the local authorities' recent impetus to position the city as an exemplar in matters of sustainability and as a 'laboratory for change' (Wainwright, 2013).

The outline of the paper is as follows. In section 3.2, we review the current literature; our aim is not to produce an exhaustive literature review but to distil crucial insights to address our question. We review the prevalent representation of how niches are formed and identify the main limitations for its application in the study of places and urban contexts (section 3.2.1). We address these issues by adapting elements of the 'contextual reconfiguration' perspective (Hodson et al., 2017), to understand how experiments, social interests, and ways of governing are assembled to reshape a particular urban context. We develop our place-based approach in section 3.2.2 and present our methodology in section 3.3. We then recount the emergence of the Bristol energy scene (section 3.4) and discuss the results of our case study (section 3.5). To conclude, we consider the implications of our study for current theories of niche formation and urban sustainability transitions research (section 3.6).

3.2 Reconceptualising how places become favourable environments for experimentation

The sustainability transitions field and, in particular, the SNM strand (Geels and Raven, 2006; Kemp et al., 1998; Schot et al., 1994; Schot and Geels, 2008; Smith and Raven, 2012) deals extensively with how niches are formed, but only implicitly with

how this unfolds spatially. Building on a quasi-evolutionary view of sociotechnical change, this body of work highlights the mechanisms of variation, selection and retention which modulate which ideas, concepts and designs attain widespread purchase. Its core focus is, however, on understanding selection. Experimentation with alternative technologies and practices is perceived as a desirable strategy to increase the chances that variations may become selected. This is salient in the case of sustainability because most radical variations (innovations) for sustainability tend to be suppressed by the selective pressures exerted by an entrenched set of rules which form the sociotechnical regime (Grin et al., 2010). Incremental innovations tend to be retained while radical innovations often perish without the necessary support. From a quasi-evolutionary perspective, we thus focus on the question of how and why variation is more intense in certain places.

Pioneering work proposed that radical variations for sustainability happen because of the existence of niches and suggested they could be created through deliberate experimentation (Kemp et al., 1998; Schot et al., 1994; Verheul and Vergragt, 1995). These spaces were theorised as alternative selective environments with rules, conditions and resources that are distinct from those encountered in the mainstream selection environment. These conditions enable actors embedded in these spaces (niche actors) to experiment and learn about novel technologies, practices and conceptions. By managing the development of niches, governments and other social groups could promote regime shifts towards sustainability. As many historical case studies demonstrate, this process is never automatic or deterministic; whether transitions happen depends on the confluence of many developments which cannot be predicted, and involved conflict between niche and regime actors, as conceptualised in the MLP (MLP) (Geels, 2002; Rip and Kemp, 1998; van Driel and Schot, 2005).

Initially, scholars focused on niche-internal processes, aiming to identify strategies for managing niches and enact transitions. According to their findings, niches can be developed by strategically initiating experiments—'planned initiatives that embody a highly novel socio-technical configuration likely to lead to substantial

(environmental) sustainability gains' (Berkhout et al., 2010) (see also Sengers et al., 2016, for a recent review of the concept).

This early empirical work dealt with how the social, cultural, material and institutional structures within cities or regions influence the development of protective spaces but did so using the analytical categories of the MLP which were not explicitly geographical.

As human geographers have recently shown, this meant that the places where experiments 'take place' have been treated primarily as a location or site where aspects of socio-technical systems are located (Coenen and Truffer, 2012; Murphy, 2015). Thus, the analytical tools downplayed two other dimensions which are crucial for understanding places: locale or place as the concrete and historically contingent settings in which social interaction occurs (sometimes referred to as situation), and sense of place, which refers to the affective or subjective orientation that ensues from living in a place (Agnew, 1987, 2005). As Murphy (2015b) argues, attending to these dimensions matters because

> Meanings, identities, histories, and situations shape the political dynamics of planning and policy making, provide senses of unity or division within communities, and/or serve to stimulate the rise of social movements that seek to improve socioeconomic conditions, address environmental problems, and/or advance ideological agendas.
>
> (Murphy, 2015)

Ignoring these dimensions leads to a degree of indifference about where niches develop, and transitions unfold (Coenen et al., 2012), and to the implicit assumption that niches can be constructed anywhere if the right processes are in place.

3.2.1 Local-Global model and its limitations

This partial understanding of place can also be found in the local–global model, which further conceptualised the relationships between experimentation, niche formation, and prospective transitions (Figure 1) (Geels and Raven, 2006; Smith

and Raven, 2012). This model depicts niche formation as emerging from aggregation and learning through a sequence of experiments which may be dispersed geographically. Initially, a proliferation of experiments emerges, informed by the inadequacies of the existing sociotechnical regime, the pressures from a macro-context (landscape), and the local conditions in multiple localities, generating variety. For the emergence of experiments to take place, the shielding of niches is necessary: these are processes modulating the pressures exerted by the dominant regime (Smith and Raven, 2012). The theory distinguishes two forms of shielding: passive shielding when niche-actors benefit from pre-existing geographical, institutional and cultural features; active shielding when actors deliberately and strategically seek to create protective spaces (Smith and Raven, 2012). This also allows analysts to distinguish passive and active protective spaces.

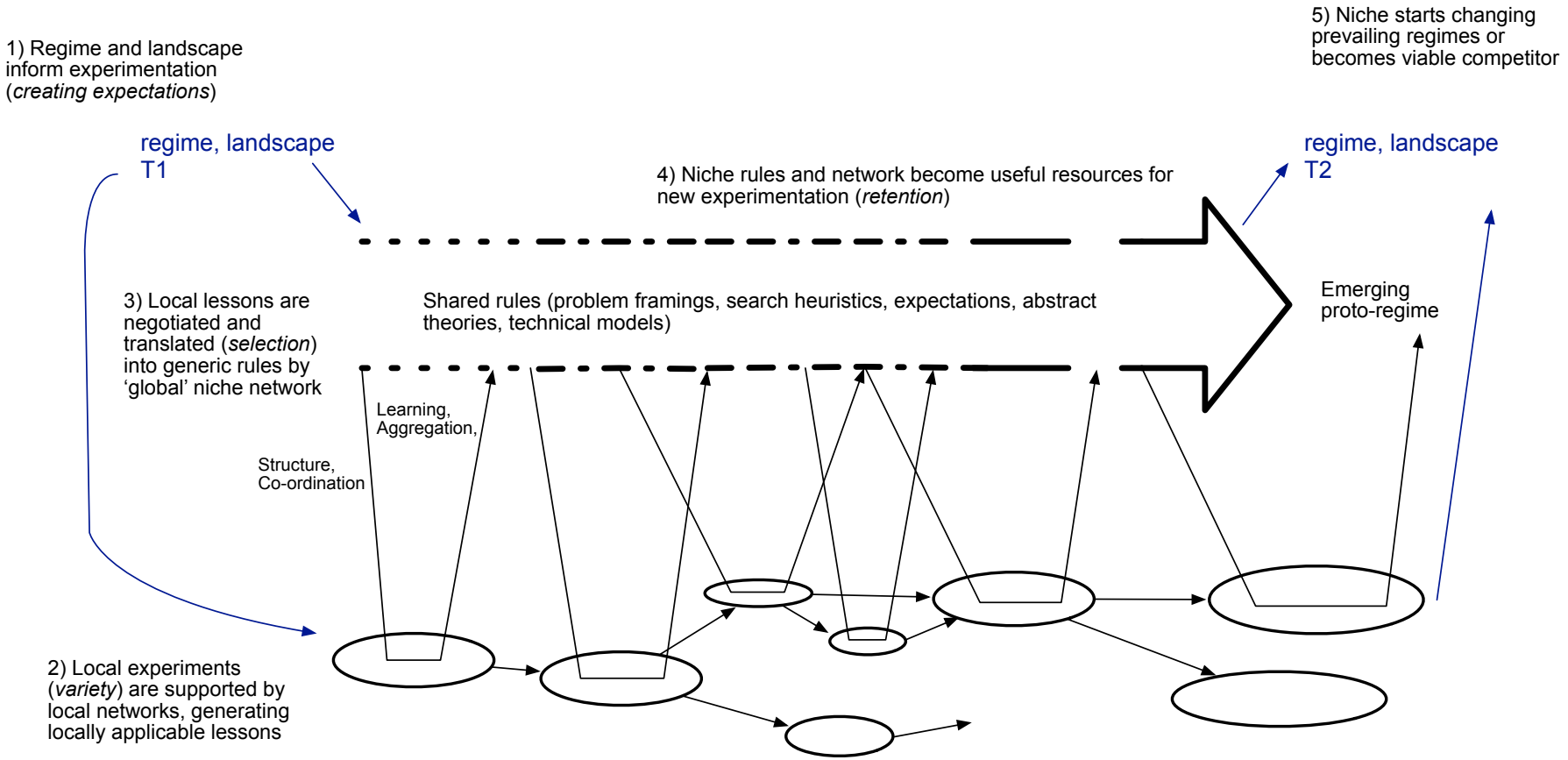


Figure 3.1 Local–global model for niche development, adapted from Smith and Raven (2012) with permission from Elsevier. Permission regarding Geels and Raven (2006) *was also granted by Taylor and Francis (www.tandfonline.com).*

Protective spaces can also nurture path-breaking innovations through (i) assisting learning; (ii) the strengthening of social networks; and (iii) articulating expectations [18]. Intermediary actors play an important role in the nurturing process. In particular, they are crucially important for aggregating and translating the lessons generated in experiments (Figure 1). Gradually, the accumulation of local lessons may lead to the emergence of a set of shared rules and routines, in a global or trans-local institutional field, that further protects experiments from the selective pressures of the dominant regime (Smith and Raven, 2012). For example, International consultancies, conferences, and standard-setting organisations connect local processes, share best practices, and establish standards, thus helping to structure (through framing and coordination) local activities (Geels and Deuten, 2006). As shared rules consolidate at this global level, and the niche continues to expand, further experimentation tends to be framed by reinterpretations and reinventions of a generic emerging technological trajectory (Raven et al., 2008). This may give rise to a proto-regime—a working socio-technical configuration with the potential to compete and challenge the existing regime—and ultimately provoke a regime shift to sustainability under the right conditions (Geels and Schot, 2007; Kemp et al., 1998).

Much of the SNM literature is concerned with how a sequence of experiments in different localities contribute towards the development of non-situated niches—also referred to as global niches—that may bring about transitions of sociotechnical systems (e.g., energy system, water system). This perspective emphasises the process of developing shared lessons and sees the building of shared vision and expectations around a particular sociotechnical trajectory as necessary for niche development. Intermediaries carry out the articulation of expectations, which supposedly mitigates some of the potential conflicts about alternative visions for future developments. Studies tend to trace niches in their journey towards becoming a proto-regime, foregrounding promising experiments with technologies such as solar PV, wind turbines, and fuel cells, and the actors directly implicated in developing them (including engineers, designers, and users).

Recently, spatially explicit reconceptualisations of this model were proposed (Fontes et al., 2016; Sengers and Raven, 2015) but were also targeted at transnational niches. Beyond an initial focus on radical technological innovation in energy, mobility, food, and other societal systems organised primarily at a national scale, SNM-inspired conceptualisations figure in debates about urban experimentation (Bulkeley et al., 2015b; Evans et al., 2016) and grassroots innovations (Longhurst, 2015; Seyfang and Smith, 2007; Wolfram, 2018a). Nevertheless, the local–global model and its spatialised versions remain most suited for studying the aggregation of similar or complementary experiments occurring in multiple localities, but which challenge a single sociotechnical system. There has been little attention to how particular places evolve as favourable environments for experimentation with sustainability.

It is tempting to address this question using the local–global model, assuming that a place becomes a favourable environment through the gradual build-up of experiments situated there. The recent geographical turn in sustainability transitions literatures (Coenen and Truffer, 2012; Hansen and Coenen, 2015; Truffer et al., 2015), however, levies three important limitations to such an approach.

First, various studies highlight the *multiplicity of urban experimentation*. Assuming that experiments accumulate gradually to form a distinctive trajectory risks neglecting the contested, 'multi-interest', and political nature of the urban context (Heiskanen et al., 2015). Urban forms of experimentation are not framed by singular socio-technical trajectories (Truffer et al., 2015). Instead of assuming an undisputed set of shared rules as the outcomes of experimentation, we should address how distinct framings and visions are made, mobilised and contested (Blanchet, 2015; Hodson and Marvin, 2010; Murphy, 2015). Local stakeholders often experiment with multiple socio-technological pathways and have to negotiate a variety of interests and visions (Hodson and Marvin, 2010; Quitzau et al., 2012; Schwanen, 2015). Urban experiments are initiated by a variety of actors, often overlap, compete for resources and open up opportunities for political action, and thus do not conform to assumptions implicit in SNM' approaches (Bulkeley and Castán Broto, 2013). Instead, experiments may act as a critical site for urban climate

politics, which 'could provide grist in the urban mill, creating conflict, sparking controversy' (Bulkeley and Castán Broto, 2013, p. 367). In this view, the 'aggregation of learning occurs not only in a "global niche community", but also in the multi-interest context of local politics' (Heiskanen et al., 2015, p. 151). These insights led us to reconsider the assumption that a sequence of experimentation informed by a particular trajectory is responsible for the formation of a protective space and focus more on the contestation around differing visions for urban transitions.

Second, *place-specificity* needs to be considered because experiments reflect the character of a place in which they are situated, and in turn, may help reinforce that character. Protective spaces and the kinds of experiments they harbour are contingent on place-dependant factors (Hansen and Coenen, 2015) such as formal and informal institutional configurations (Raven et al., 2012); the buzz of intense face-to-face interactions, inter-organisational relations and the clustering of organisations (Asheim et al., 2007; Sengers and Raven, 2015); the vibrancy of local grassroots organisations (Berkhout et al., 2010; Longhurst, 2015); and the geographical proximity to natural resources endowments (Coenen et al., 2010). These factors matter in explaining why certain places are more likely to spur experimentation, but also in understanding the style of experimentation prevalent in a place (Raven et al., 2017b; van den Heiligenberg et al., 2017). Our approach builds on these richer accounts of how place-dependant factors enable the actors embedded in these places and is attentive to the three-dimensional understanding of place outlined by Agnew (1987, 2005) to characterise what patterns of experimentation arise due to these factors.

Third, the analysis should attend to the '*co-existence and interdependence of local and non-local relationships*' (Hansen and Coenen, 2015, p. 105). Conflating niches with the local scale obscures processes of social change that sustain or threaten protective spaces, but which are not captured by describing local–global iterations or niche-regime interactions. These encompass (un)stable multi-level institutional arrangements that shape the capacities of sub-national authorities to support experiments, and which can result in path-dependent styles of experimentation (McGuirk et al., 2014; Raven et al., 2017b), crises or windows of opportunity that

spur experimentation (Blanchet, 2015), and discursive shifts repositioning cities as crucial spaces for redressing climate change (Hodson and Marvin, 2007). These observations suggest we should consider multi-scalar relationships and interrogate the stable and unstable periods of formation of a favourable environment for experimentation.

3.2.2 Elements of a place-based approach

To address these limitations and understand how a favourable environment for experimentation emerges in an urban context, in the long run, we argue that a place-based approach is necessary. Rather than focusing only on promising experiments feeding into niches that emerge and grow at a trans-local level, we now explore the building blocks for an approach that takes on the standpoint of a place while building on the insights from the local–global model.

Contextual reconfiguration

To address the issue of multiplicity, we draw on a broader understanding of urban experimentation recently proposed by Hodson et al. (2017). They focus on how a particular place is reconfigured through a wider set of urban experimental processes 'of assembling technologies, social interests, and new modes of governing into place-based configurations and learning about these processes of embedding an infrastructure or a scheme in a particular place' (id., p. 6). Conceptualising urban transitions as processes of contextual reconfiguration, they propose to unpack the (id., p. 13) competing, coexisting and complementary interactions between multiple experimental processes which generate new place-based configuration. Although the focus on reconfiguration is useful (see the comparison in Table 3.1), this approach is not explicit about how a given context becomes favourable for experimentation. To handle this task, we need to integrate three more concepts already present in the literature, namely settlements, modes of governing and patterns of experimentation.

Table 3.1 Contrasting assumptions and analytical dimensions of the different approaches.

Analytical Dimensions	**Local–Global Model**	**Contextual Reconfiguration**	**Our Approach**
Assumption about emergence of a favourable environment for experimentation	Niche formation as the outcome of intentional efforts to develop niches and gradual accumulation of lessons from experiments in a trans-local level, which support further experimentation (Figure 3.1).	Not directly applicable	Formation of a place-based niche formation as the outcome of a process of contextual reconfiguration, driven by interactions between multiple urban experimental processes embedded in a place. This process is affected by multi-scalar relationships and open to contestation and is potentially discontinuous. Over time, viable place-based configurations may emerge, reconfiguring the urban context and its systems (see Figure 3.2)
Assumption about the interplay between experimentation and urban transition	Not directly applicable	Multiple urban experimental processes embedded in a place being assembled into place-based configurations, reconfiguring the urban context and its systems	
Experimentation	How aggregation and learning from multiple experiments contribute to developing a niche?	How multiple urban experimental processes interact within a city?	What patterns of experimentation emerge and how do they contribute to developing a favourable environment for experimentation?
Intermediation/Governance	How do intermediaries and niche actors develop the niche?	How interactions between different modes of governing influence urban experimental processes?	How interactions between different modes of governing influence urban experimental processes?
Expectations/understandings of sustainability	How are expectations of different actors aligned?	What understandings of sustainability prevail in shaping experimental processes and who promotes them?	During different settlements, what understandings of sustainability and interests prevail in shaping experimental processes and who promotes them?

Settlements

The concept of settlements helps to address the multi-scalar relationships and contested nature of urban experimentation. In studies of local politics, Ward (2000) conceives settlements as periods demarcated by the existence of stable institutional or governance arrangements that emerge from the accommodation of interests at the intersection between national level politics and local concerns (e.g., the intersection between the development of a neoliberal state and local regeneration policies). This also resonates with Raven et al.'s (2017b)study of how situated institutional arrangements, which result from the interplay of inter-scalar processes and relationships, inform and are reproduced through particular styles of experimentation. When a settlement emerges, framings promoted by powerful actors may dominate public discussion, leading to recognisable patterns of intervention by local authorities. Similarly, settlements figure in theorisations of 'strategic action fields' that are fruitful in the study of grassroots activism (Blanchet, 2015). Here, actors are seen as embedded in 'socially constructed arenas within which actors with varying resource endowments vie for advantage' (Fligstein and McAdam, 2012, p. 10). Mutual dependence between actors means that episodic contention or instability due to external shocks can give way to settlements, re-establishing collaboration, orderliness, with a dominant frame of what is at stake (id.).

Drawing from these perspectives, we conceive settlements as the periods with stable constellations of actors and prevailing framings of what is at stake, resulting in particular patterns of activity (different patterns of experimentation, in our case) and modes of governing this activity. Settlements emerge from temporary standoffs between actors, which result from contestation and cooperation and exposure to external pressures. This concept, combined with the notion of contextual reconfiguration, can support accounts of the long-term evolution of a given place (Figure 3.2). Here, instead of assuming that experiments are part of a long sequence which contribute inexorably towards developing a socio-technical trajectory, the history of how a place comes to be configured as a favourable environment for experimentation can be analysed as a sequence of settlements

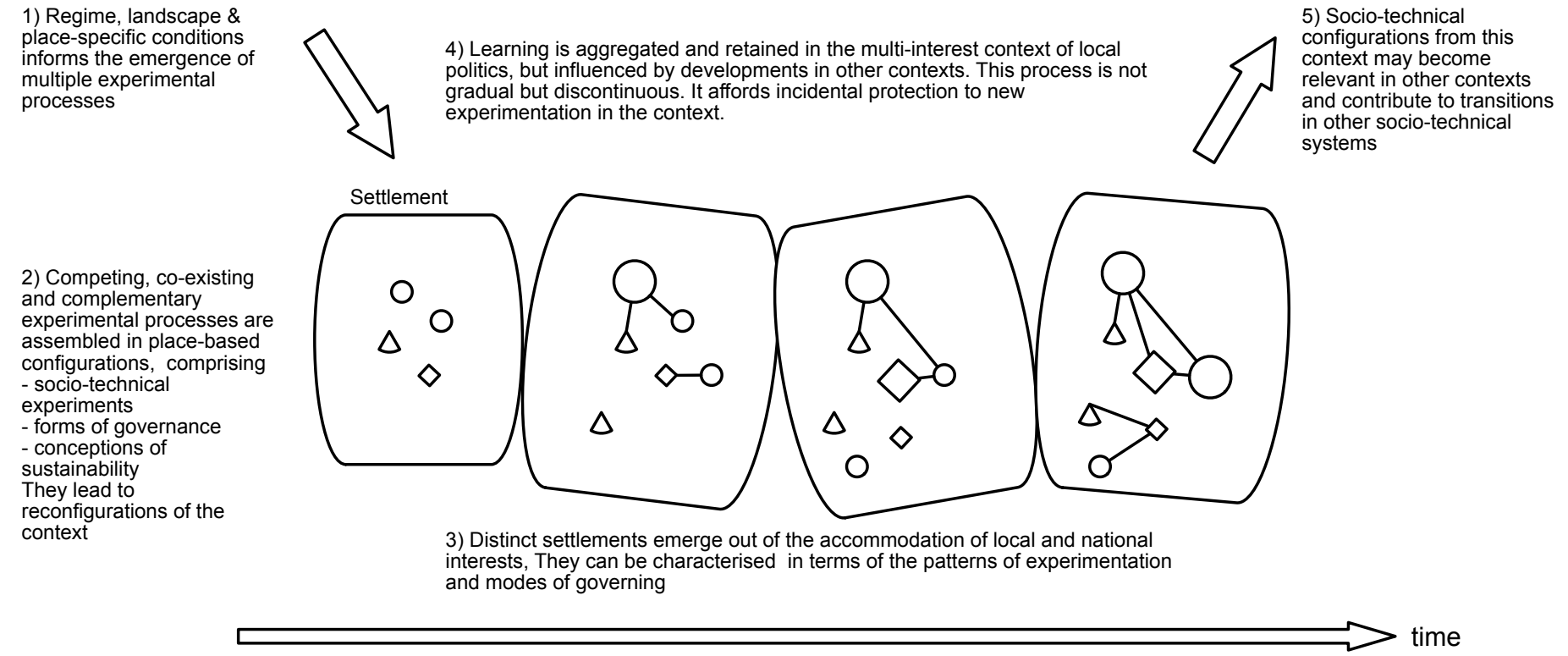


Figure 3.2 Place-based approach for analysing the evolution of favourable environments for experimentation, adapted from the local–global model and contextual configuration.

Modes of governing

To characterise the prevailing interactions between different forms of urban governance within a settlement, we draw from an established typology of modes of governing. Based on a study of municipal climate action in the UK and Germany, Bulkeley and Kern (2006) delineate four distinctive but overlapping modes of governing climate change in cities: *self-governing*, comprising activities whereby the local government manages its own activities; *governing by provision*, comprising the delivery of particular forms of service and resource to shape new practices; *governing by authority*, the use of traditional forms of authority such as regulation and direction which persist despite reforms; *governing through enabling*: 'facilitating, co-ordinating and encouraging action through partnership with private- and voluntary-sector agencies, and to various forms of community engagement'.

Other studies demonstrated that in different periods municipal authorities are capable of mobilising specific modes of governing. Bulkeley and Betsill (2013), for example, identify that in the early 1990s, local authorities in Europe were largely reliant on voluntary self-governing measures, for which they denoted an era of 'municipal voluntarism'. Around the 2000s, with the mainstreaming of climate change, municipal authorities sought to expand their capacities to deal with climate change and integrate it into other imperatives such as economic development and intercity competition, with the enabling mode of governing gained prominence in an era of 'strategic urbanism'. There is evidence that a new era of governing by experimentation is emerging, with actors explicitly framing their interventions in experimental terms or proactively seeking to create urban laboratories as dedicated spaces for experimentation (Bulkeley and Castán Broto, 2013; Karvonen and van Heur, 2014). Our study contributes to these discussions by examining an instance of this trend, interrogating how this mode of governing emerges as a viable option in a particular context and unpacking how it relates to other modes of governing.

Patterns of experimentation

Attentive to observations that particular styles of experimentation tend to be privileged by situated institutional arrangements (Raven et al., 2017b), and calls for richer accounts of how this occurs (Truffer et al., 2015), our approach characterises the *patterns of experimentation* that emerge in different settlements. Existing typologies of experiments fall short of this task because they take individual experiments as a departing point or assume that there is a singular experimental style in a place (Raven et al., 2017b; van den Heiligenberg et al., 2017).

Our interest in exploring patterns of experimentation stems from acknowledging the multiplicity of urban experimental processes, which demands attention to who carries out these processes, how they are being framed, and whether they are complementary, competing or co-existing with one another (Hodson et al., 2017). For example, in a given settlement, do-it-yourself community projects aimed at local empowerment may develop with complementarities with government-led experimental business models for city-wide energy provision aimed at economic development, and in another settlement, the relationships between these initiatives might become competitive. Observing these distinct patterns, instead of conflating them as a single style allows a more nuanced account of the formation of that environment. As we are interested in exploring how these patterns arise, we seek to elicit them from the case study.

In sum, we propose that a place-based niche can be formed through a process of contextual reconfiguration, whereby multiple urban experimental processes embedded in a particular place become assembled into socio-technical configurations that comprise specific technologies, modes of governing and conceptions of sustainability. The temporal evolution of these configurations tends to be discontinuous and jagged, as they are subject to multi-scalar relationships and contestation. To best study these discontinuous and varied processes, we analyse the sequence of different settlements, highlighting the modes of governing and patterns of experimentation that arise. We use this approach to trace the development of a favourable context for experimentation in Bristol.

3.3 Methodology and data source

Our objectives entail a methodology capable of identifying the salient processes involved in the emergence of a favourable context for experimentation in Bristol and understanding its changing character over a long period. The limitations we identified in the literature demand a processual, relational and nuanced account of this journey that can capture the historically contingent, situated and contested character of places (Murphy, 2015). Thus, we adopted a case-study approach because of its suitability for an in-depth examination of context-specific, multi-actor processes, and the possibility of combining different forms of evidence (Yin, 2014). In developing our case narrative, we followed an iterative process of matching existing theory and empirical observation and fitting the framework above and the case in Bristol. Our research journey can, a posteriori, be described as an instance of 'systematic combining': 'a nonlinear, path-dependent process of combining efforts with the ultimate objective of matching theory and reality' (Dubois and Gadde, 2002, p. 556). In that journey, we benefited from the recent publication on contextual reconfiguration, which addressed some shortcomings of our preliminary framework and offered a better matching with our observations and led to a redirection in the study.

We adopted a process approach to this research. Process approaches are concerned with how and why things evolve and examine events and contextual processes implicated in a particular case. This is congruent with conceptualisations of systemic change that emphasise reconfiguration (Geels et al., 2015). The process approach enabled us to focus on the entities that participate in events and assume that the set of entities may change over time (e.g., as new actors come forward). The complexity of these events is captured in a case-narrative. In the process approach, generality depends on the versatility of the patterns and mechanisms identified: it matters whether they explain the processes of wider category (Van de Ven and Poole, 2004). In this study, our approach has to be adaptable to study how and why favourable environments for experimentation emerge in particular places.

In selecting the case study of Bristol, we were motivated by observing that it comprises levels of grassroots mobilisation and local government engagement, which span various domains of sustainability, are broadly oriented towards civic goals and has been active since the 1970s (Amin et al., 2002; Brownlee, 2011; Purdue et al., 1997). We, therefore, considered that Bristol represents an extreme/deviant case (Flyvberg, 2001) because its diversity, persistency and directionality that are atypical in the UK.

The data collection consisted of desk research of the available academic literature covering developments in Bristol's civil society and governance, complemented with 10 semi-structured interviews (see 8, p.290) with stakeholders providing an insiders' perspective into the activities and efforts to structure the Bristol Energy's scene. These interviews were realised during three site visits between July 2015 and August 2016. Thematic and open coding on N-vivo was used to elicit the main events. They were triangulated with archival research in the Bristol Archives, covering the material collected by the Green Roots project (Brownlee, 2011), official documents appertaining to energy-related activities of the local government; and secondary sources covering key events (newspapers, reports and policy documents).

3.4 Evolving context for civic energy experimentation in Bristol

In this section, we recount the evolution in Bristol of a favourable environment for experimentation with civic forms of energy provision. We trace the contextual reconfiguration of the alternative milieu in Bristol through four distinct settlements.

3.4.1 First settlement

In this settlement, the proliferation of grassroots activism led to the emergence of an alternative milieu in the city. Bristol's environmental movement can be traced back to the late 1960s and 1970s. In 1966, a modernist plan for the regeneration of

the city centre sparked a wave of protests that questioned its social and environmental implications. The protesters were successful in stopping the plan. From its mobilisations, different activist groups began coalescing, including Bristol and Avon Friends of the Earth (BFOE, in 1971), Urban Centre for Alternative Technology (UCAT, 1979, now Centre for Sustainable Energy), and Cyclebag (1977, now SUSTRANS). Local environmental activism was emboldened by the nascent global environmental movement which had grown around concerns over pollution, fossil fuel dependence and the risks of nuclear power. They shared a sense of urgency, a distinctive political orientation close to anarchism (Barton, 2009), and the emerging canon of the global environmental movement, of which Schumacher's *Small is Beautiful* was particularly influential (Schumacher, 1973). These influences inspired initiatives challenging the reliance on centralised large-scale infrastructures, arguing for more socially and environmentally attentive systems of provision appropriate to local circumstances (Barton, 2009; Brownlee, 2011). Many groups in Bristol adopted a 'do-it-yourself' (DIY) ethos that was widespread in the south-west of England and Wales (Purdue et al., 1997).

Under these influences, experimentation in this period followed a pattern of small-scale, practical solutions, often involving bricolage with locally available resources (Garud and Karnoe, 2003) although informed by conceptual innovations emerging in other localities. This was pursued in parallel by various groups, which found some complementarities as they began to agglomerate. A significant example was UCAT, which was established to bring alternative technology to the urban context, by activists who had visited and studied at the Centre for Alternative Technology (CAT) in North Wales. Thematically, the centre focused on energy. It operated as a cooperative and grew quickly, attaining 400 members in 1982 (Brownlee, 2011). It intended to combine activities in exhibition and information; demonstration; education and social development (Barton, 1980). One such initiative was the 'Future Home', the first low-energy demonstration house in the UK, which hosted multiple experiments with a holistic perspective on energy autonomy, around which 'were woven many strands of thinking (…) food and soils, water, the reuse of old buildings, user-control, satisfying work, access for all, and integration with

the wider community' (id.). UCAT was intended as 'catalyst for new beginnings', working closely with other groups in the city to 'nurture (…) seed-points of social renewal', and highlighting the 'interrelatedness of apparently disparate movements: e.g., cycling, wholefoods, anthroposophy' (id., p. 7). Another of its initiatives, the Green Leaf bookshop, became a cornerstone of a cluster of activism that formed in Colston Street, that emerged in the 1980s when a property developer started offering low-cost rentals for environmental organisations (Brownlee, 2011). This place became an early embodiment of the green and alternative milieu in Bristol, increasing its buzz and facilitating the contact between different groups and exchange of ideas and knowledge.

In the energy domain, practical experiments went hand-in-hand with direct action opposing hard energy paths. Environmental groups in Bristol were pre-eminent in mobilisations against the expansion of Nuclear Power in the UK, in part due to the geographical location near Hinckley Point. The south-west region had, at that point, four nuclear reactors; nuclear waste carriers crossed the Bristol railway lines(Brownlee, 2011). Through their experiments and mobilisation, BFOE and UCAT and other environmental groups developed a combination of tacit and technical knowledge about energy and environmental matters and critical knowledge about the political economy of energy in the UK, becoming a critical voice in National policy debates. They were also grounding these debates in their local context, advocating action by the council and informing the population. In 1990, for example, the BFOE convened a city-wide Energy Group, whose invitation letter remains surprisingly relevant three decades later:

> There is confusion in the Government on Energy issues: nuclear power has shown itself to be very expensive, yet the Government is trying to keep it open as an option. Plans for nuclear waste disposal are non-existent. Renewable energy is becoming accepted to some extent (…) but there are few clear national directives on this. Energy Conservation has been demonstrated to be one of the most immediate ways of cutting carbon dioxide emissions, but the government has refused to take any steps to promote conservation (…).
>
> (BFOE, 1990)

In this period, the local government was largely disempowered to tackle emerging environmental issues, only tentatively developing an enabling mode of governing. In the energy domain, it had very little discretion, as a vertically-integrated regional company had been formed in 1948 and privatised in 1990 (Lamb, 2004). Local environmental groups and other volunteering organisations drew support primarily from central government funding. They also sought partnerships with a weakened local authority, but this support was unstable. During the Thatcher Conservative Government (1979–1990), Westminster adopted a directive approach to urban policy (DiGaetano and Klemanski, 1999). A series of reforms curtailed the local discretion over spending with public services; councils were expected to act as *contracting authorities* (Wilson and Game, 2006). The accompanying neo-liberal reforms positioned volunteering as a desirable substitute for state provision of public services; central government Initiatives such as the Youth Opportunities Programme and Community Programme helped expand the third sector (Crowson et al., 2011). Funded by these, local groups pursued partnerships with the Bristol City Council (BCC), which also dedicated a large share of its central government funding to supporting local charities. These programmes and partnerships provided groups with core funding, rather than project-based grants. When the financial situation was good, they could staff campaigns and services and expand to address the demand for services such as kerbside waste collection, energy advice and training, and building of cycling routes (Brownlee, 2011). For example, Simon Roberts, later director of the Centre for Sustainable Energy (Box 1), was one such volunteer in the building of UCAT's visiting centre. Nevertheless, most groups were mired in 'chronic insecurities generated by frequent switches of programmes and policy emphasis' (Crowson, 2011). Despite its supportive stance, BCC's leadership and organisational capacity were constrained (Bassett, 1996; DiGaetano and Klemanski, 1999). Between 1974 and 1996, a two-tier governance arrangement compounded this situation:

> (…) we had a quite weak council, partially because for a long time it was two tiers [with Avon County Council] (…) the county council that seemed quite desperate not to be too Bristol centric (…) even when it became a unitary authority [1996] it didn't have a tradition of municipalism which you would tend to find in northern cities (…) where the expectation is that the public sector will provide, lead and be the locus for action.
>
> (interview with Simon Roberts OBE, Director of CSE).

Hence, local environmental groups were growing and forming partnerships with the council but lacked coordination. Despite the agglomeration around Colston Street, and the efforts of intermediaries such as the Bristol Voluntary Sector Council and Bristol Community Groups Network, the alternative milieu was fragmentary and fiscally dependent (DiGaetano and Klemanski, 1999), resulting in duplication and rivalries between groups.

> (Bristol) It's a very interesting place and a very interesting city for grassroots initiatives. There's more here than anywhere else. We usually have not one but at least two of everything (…). We are not the only place for anything, and we learn from others, but when we do it there's lots that happens. Sometimes rival, rival projects.
>
> (Interview Councillor Martin Fodor)

3.4.2 Second settlement

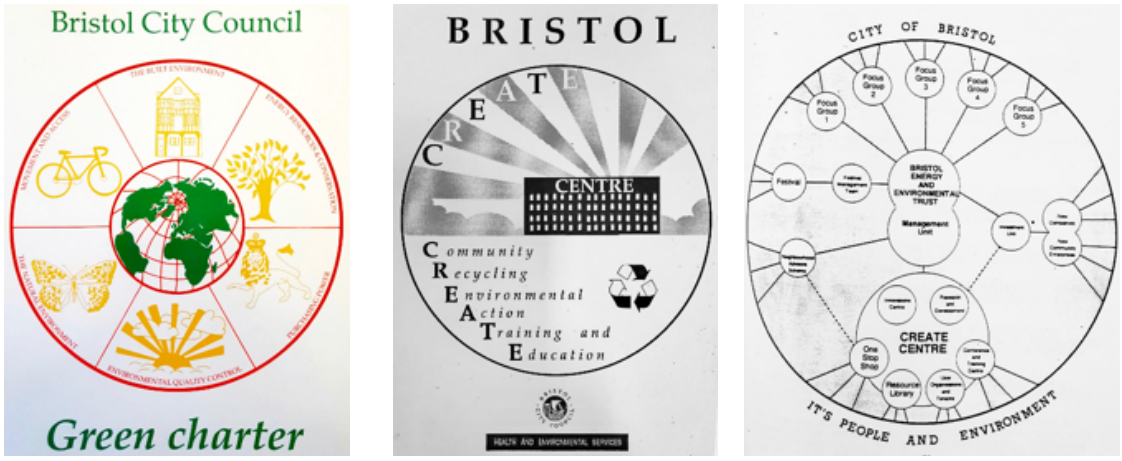
In the late 1980s and early 1990s, the alternative milieu in the city consolidated thanks to the institutionalisation of the sustainable development agenda, the associated attempts by the local authority to support and enable local action, and the growing attractiveness and reputation of the local cluster of environmental organisations. This came in the wake of the Brundtland Commission in 1987, Rio Conference in 1992 and Local Agenda 21 in 1993, which opened space for a more proactive local authority engagement. In response to the mainstreaming of environmentalism, Westminster took tentative steps towards establishing an institutional basis for action of sustainable development, emphasising the need for policy coordination while avoiding substantial commitments (Voisey and O'Riordan, 1997). Local authorities were placed rhetorically at the front line of sustainable development and expected to develop 'local agenda 21' strategies in

consultation with the public. Compounding these developments, national reforms were demanding local authorities to take on a proactive 'enabling' role in the form local partnerships, that were also expected to address the faltering and dissolution of the regional government. Under John Major's Conservative Government, funds from the national government were allocated on the basis of 'capacity for delivery', and local authorities were framed as '*competitive authorities*' (Wilson and Game, 2006). In this national context, Bristol was initially ill-positioned due to political reticence and opposition to public–private partnerships (Bassett, 1996). Under these pressures, a new settlement began to emerge, with the BCC assuming a proactive role, leading to city-wide attempts for coordination and the eventual consolidation of the alternative milieu.

The BCC was primarily involved in self-governing and enabling modes of governing measures, consistent with the 'municipal voluntarism' prevalent among local governments in this period (Bulkeley and Betsill, 2013). The council established a 'corporate approach' to sustainable development, seeking to consolidate pre-existing activities of its different departments, fostering new community-led engagement, and attempting to define action plans in the various domains of sustainable development (Brownlee, 2011; Coombes and Fodor, 1997). The Green Charter (1990) was an early instance of such corporate approach (BCC, 1990). A public dialogue led to the identification of potential areas for council action, which were compiled in a public document (Figure 3.3a). Campaigning groups reacted critically: 'this should have been the chance to set the national agenda for greening local Councils. Instead, the politicians will only adopt those 'green' policies which won't cost them any money or cause them any problems' (BFOE, 1990). Nevertheless, BCC began consolidating internal capabilities while assisted by local environmental groups. In 1991, for example, the council published Bristol Energy and Environmental Plan, developed by UCAT (briefly renamed Bristol Energy Centre), highlighting opportunities for reducing the city's energy demand (BCC, 1994a). Subsequently, it established an Energy Management Unit (EMU), responsible for awareness raising and promoting energy efficiency in the Council's buildings. The EMU reinvested the savings it achieved to remain self-

funded. Besides the EMU, a multi-disciplinary Sustainable City team (1994) was established for convening and coordinating sustainability-related activities from different departments and develop a strategic direction. This team also intermediated between the city's environmental groups and BCC. Officers in these units were active in trans-municipal networks such as Eurocities and Energy Cities, and European efforts for connecting experts in sustainable development, which also involved the city's two universities, which reflected a Europeanisation and internationalisation of sustainable development activities (Emelianoff and Mor, 2013). Together, these developments allowed the council to amass expertise and to identify new opportunities for municipal action in sustainability, learning from cities where other modes of governing were prevalent.

This led to a change in the pattern of experimentation, as the council became more proactive in shaping the alternative milieu, and a growing number of municipal initiatives that enrolled grassroots groups. This included many energy-saving and awareness initiatives led by the local government, new spaces for demonstrating eco-technologies, and an emphasis on developing collaborative structures. At this point, the groups providing recycling activities were in need of space to expand their activities and managed to lobby the local government to refurbish a warehouse on the outskirts of the city (Brownlee, 2011). This led to the development of the CREATE centre (Figure 3.3b). that housed the Sustainable City Team and various groups established in the previous decade. It was managed by a trust (Figure 3.3c). which administered the CREATE centre, managed an 'investment 'investment unit', and ran a festival for awareness raising. An EcoHome was also built on the site, to act as a visitor's centre, testbed and showroom for various technologies associated with sustainable housing and energy efficiency. The CREATE aimed at replicating the buzz that was found in Colston Street in the previous decade. This kind of activity created new interfaces between the council, grassroots groups and social enterprises, facilitating the 'percolation between the associative and community dynamics and the mobilisation of the municipal teams' (Emelianoff and Mor, 2013, p. 216).



(a) *(b)* *(c)*

Figure 3.3 (a) Cover of Bristol Green Charter (BCC, 1990)*; (b) Create Centre brochure* (BCC, 1994b)*; (c) Bristol Energy and Environmental Trust envisioned organisational structure* (BCC, 1994a).

Nevertheless, local collaboration was still limited because of a turbulent funding landscape. For grassroots organisations, funding was increasingly project-based, with contractual relationships, instead of core funding (DiGaetano and Klemanski, 1999). This demanded greater professionalisation in the management of their activities. Groups in Bristol benefited from the support of intermediary organisations that worked on behalf of civil society at large (e.g., volunteering networks), which provided training and consultancy, and helped them to establish issue-based social enterprises. These were 'run by middle-class professionals who were delivering the social economy on behalf of local people' (Amin et al., 2002). The ensuing professionalism improved chances of success for new ventures and increased the visibility of the alternative milieu nationally. It also generated continuous recruitment of members of a 'green middle class' (id.). In the coming decades, Bristol saw the rise of a large contingent of social entrepreneurs. To sustain their funding and increase their impact, these social-enterprises were expanding into regional and national 'markets'. Early groups specialised in various domains of the environmental movement and began acting as knowledge brokers and intermediaries with a national reach (Brownlee, 2011), which in turn constrained the possibilities for local collaborations.

> (…) (for) those main organisations—SUSTRANS, Soil Association, ourselves, Resource Futures, nationally significant organisations, sectoral, theme-based organisations—there hasn't been a place where we have all been getting together (…). The effort required to bring us all together, compared to the value we each got out of it (…) never quite added up. (…) the next best thing to do for each of those organisations were to do more of their own thing, rather than work out how, on a local all, and integration with the wider community links.
>
> (Interview with Simon Roberts)

Despite the difficulties fomenting local collaborations, the reputation and connectivity of the alternative milieu engendered a self-reinforcing dynamic. Attracted by Bristol's vibrant 'green' hub, various private and public organisations began to locate their headquarters in the city. The participation of energy and environmental services in the local economy increased. In the mid-1990s, the city welcomed the headquarters of Triodos, a Dutch ethical bank; Wind Prospect, a wind power consultancy; Solarsense, a developer of solar installations; and the UK's Environmental Agency, then one of the largest environmental protection agencies in the world (Voisey and O'Riordan, 1997). This influx diversified the career opportunities that could be found in the milieu. Hence, the city could attract and retain like-minded individuals, who were also drawn to other features of the city, such as its bohemian and alternative outlook, music scene (in this period, Bristol was the cradle of trip-hop and drum-and-bass and an early hotspot of street art), good universities, natural surroundings and relative prosperity (Brownlee, 2011):

> 'Lots of those things come together, and the fact that it has a highly-educated group, that tends to attract other people who like being with people like that (…) it starts to fuel its own fire'.
>
> (Interview with Simon Roberts)

This influx further diversified the alternative milieu, which harboured people from various walks of life. Volunteer, social entrepreneur, activist, professional and political identities overlapped.

> Everyone in the third sector believes that they lead, and the council follows. And I am sure that there are people in politics that think the other way around. And the reality it is iterative and self-reinforcing. I think there is a bigger, wider, organic thing about the city attracting, both growing home-grown talent (…) and then attracting (green-minded individuals), that would go work for the voluntary sector, business and council. There is no difference, *people in that movement get jobs in all sectors*.
>
> (Interview with Marc Leach, our emphasis)

As in the previous settlement, experimentation with alternatives co-existed and complemented the combative environmental activism and the critical engagement with matters of national policy. In the energy domain, CSE continued to support new groups in the city and to gather expertise in energy advice and energy efficiency. Direct action and opposition to large-scale infrastructure continued, but often in opposition to Westminster. BFOE and the Bristol office of Greenpeace, for example, were involved throughout the 1990s in protests against the expansion of nuclear power, and most major protest cycles in the UK (Brownlee, 2011). The interplay between these groups and the council were increasingly important in the alternative milieu.

> (…) we need a voluntary sector, a green pioneer movement, that can clear the way. The council cannot be the most radical organisation in the city, obviously, that would be crazy. So, of course, there are (…) thought leaders, but equally the council has pioneered and has been at times ahead of the rest of the city. So, it is often far more complex picture than this sexy narrative (…) I think that all sectors have led in different ways at different times.
>
> (Interview with Marc Leach)

3.4.3 Third settlement

By the late 1990s, a new settlement emerged from the accommodation of sweeping local-government reforms and further institutionalisation of the sustainable development agenda. In Bristol, this period brought a new stance of the local government, which contributed to the emergence of the energy scene. National and international developments continued to mainstream climate action reinforcing the local coordination. Like other European cities at that time, the

stance of the BCC became overtly political, further integrating responses to climate change to other municipal agendas, in a trend towards 'strategic urbanism' (Bulkeley et al., 2012). Consensus over the urgency of climate change and pressure from the local environmental groups led the council to start guiding its strategy with greenhouse gas budgets and renewable energy targets, which shifted the municipal strategies towards a logic of carbon control (id.). This happened early in Bristol, as the council commissioned its first emission inventory in the year 2000.

Once more, the changes in multi-level governance arrangements opened up opportunities for local government action, changing the modes of governing deployed. With the election of Tony Blair in 1997, local governance in the UK was once more shaken up, as New Labour embarked on a 'local government modernisation agenda' (Downe and Martin, 2006), underpinned by a commitment to a 'third-way' politics between the 'old welfare state' and the neoliberal lean state. This returned some strategic control over service provision to local governments, albeit with a redefined role: the local government was to exert informal influence, convening, coordinating, and acting as 'chief networker' in facilitating service improvements through local strategic partnerships (Wollmann, 2006). One such partnership was established in Bristol, building on the Local Agenda 21 (LA21), and helped embed climate change in the local political agenda.

> (…) (there was) a kind of organic growth and movement where (…) the local strategic partnership, the community strategy, the local agenda 21, that came from Rio, they provided a bit of structure and form and gave quite a specific role to the council. That in effect created a meeting point and a purpose for people to come together around. And I think that created a bit of glue, oiled the conversations, and also provided a bit of structure.
>
> (Interview with Simon Roberts)

The resulting Community Strategy Vision included the aims of achieving carbon neutrality by 2050, establishing a municipally-owned energy services company and investing in renewable energy capacity. That document expressed an 'extrospective' stance that aimed to position Bristol as the 'green capital in Europe' (The Bristol Partnership, 2003). To substantiate this vision, the Bristol Green

Capital Partnership (BGCP) was created in 2007 to deliver on the ambitions of the community strategy (Brownlee, 2017). The BGCP began congregating other institutional actors interested in sustainability and articulating the bids to the European Green Capital Award from 2008 onwards. These ambitions emerged in the favourable civic climate with a long history of cross-party engagement within the alternative milieu:

> (…) That history goes back a long time . . . all political parties have been supporters; there is no massive political difference. And I think some of that political leadership was not necessarily a response [to the environmental movement], but it was maybe enabled, maybe it was made easier because there wouldn't be the backlash (…) Politicians can only lead they cannot go. It is like an elastic cord (…) They can't lead beyond that or that cord will break, and they will be out of office.
>
> (Interview with Mark Leach)

In this settlement, the BCC's approach for controlling carbon emissions was moving beyond self-governing measures, to explore options for governing by provision. The EMU had demonstrated the potential returns of investment on energy activities, but the city was still a laggard when comparing its renewable energy capacity to other counties in the Southwest region (REGENSW, 2005). Aiming to expand its scope to encompass city-wide energy use and carbon emissions, the council contracted CSE to conduct comprehensive assessments of the city's carbon footprint and renewable energy potential.

In this period, a new pattern of experimentation emerged, which comprised both council-led initiatives to develop renewable energy projects, and grassroots initiatives were emphasising competing framings of sustainability. The Transition Bristol that began meeting in 2007 emerged as a new forum for grassroots activities (Transition Bristol, 2017). At a time of record high oil prices, transition activists were mobilising around the idea of peak oil. They convened a broad debate in the city which led the council to publish a response, supported by the BGCP, which reframed the discussion to put more emphasis on promoting a transition away from fossil fuels (Osborn, 2009). A similar process was happening at the neighbourhood level. The transition towns movement promoted an eco-localism

approach aiming at self-reliance, local collaboration and conviviality, similar to the DIY ethos of the 1970s. This spurred further experimentation, which included the emergence of a local currency (Bristol Pound) and the establishment of Bristol Green Doors, a project for demonstrating green retrofits. Initiatives that were once symbolic of a countercultural movement were now attracting praise and support from mainstream institutions.

As a result, in the late 2000s, a distinctive energy 'scene' began coalescing with a sharp increase in the number of groups working on energy-related matters, aligning with the emergence of community energy initiatives in other parts of the UK. New feed-in tariffs and sharp drops in the costs of solar were affecting the viability of renewable energy generation for grassroots initiatives, prompting experimentation with new community-led models around the UK (Walker et al., 2007a). In Bristol, new initiatives could draw support from the BCC, CSE and the wider alternative milieu. In a nationally funded project, the council commissioned CSE to survey the community energy groups in the city, receiving responses from 18 such groups. CSE also administered the Bristol Community Energy Catalyst, a seed fund that helped establish the Bristol Energy Cooperative and other community groups (CSE, 2011). Meanwhile, the milieu hosted various '(…) supportive local organisations (that) provide inspiration, moral support and common platforms through which ideas could be formulated, shared and developed' (Barnes, 2015). In this context, experimentation included distinct business models and approaches for community-led renewable energy installations, energy efficiency and energy advice. Multiple neighbourhood level groups and two energy cooperatives were founded. The Bristol Power Coop sought to develop 'solar streets', organising the installation of solar panels on rooftops of entire residential streets. The Bristol Energy Cooperative, in contrast, sought to develop solar installations on community and public buildings. Amid this diversity, the Bristol Energy Network (BEN) began meeting in Autumn 2010, 'in response to a flourishing of grassroots activity and the perceived benefits of closer collaboration' (BEN, 2017). CSE opted to partner with the BEN without leading it, maintaining its volunteer-led character (interview with Bridget Newbery). Despite

the BCC's intentions, CSE expertise, and the milieu, the support available to these initiatives was still piecemeal and makeshift.

3.4.4 Fourth settlement

The 2010s, saw a new settlement emerge as the council developed further modes of governing and adopted a more experimental and extrospective stance, while community energy initiatives began professionalising and scaling up. This settlement generated new tensions. An ambiguous relationship between the council and community energy groups emerged: on the one hand, there was increasing support for the grassroots initiatives and BEN, and on the other, the council was pursuing its own municipalist strategy, focused on the direct provision of energy services carried out by well-funded teams in the BCC. This settlement resulted in the consolidation of the Bristol energy scene, a shift in the style of leadership as the city achieved a new level of support from European institutions and elected a new mayor.

Another wave of changes in multilevel governance arrangements allowed BCC to deploy new modes of governing climate change in the city. This was given strength with a new mayoral system established in 2012, which contributed to clarifying the leadership profile of the city (Hambleton and Sweeting, 2014). George Ferguson, a prominent architect, was elected as mayor. He had a long history of engagement in the city prior to being elected. He was part of the early protests against road construction, acted as a local councillor in the 1970s and was responsible for many iconic projects in the city. He ran for election as an independent and went on to form a 'rainbow' coalition with other parties. Early on, Ferguson began promoting an overly experimental attitude: 'I'm saying Bristol is a laboratory for change (…) We are a testbed: come and try it and help me change it' (George Ferguson quoted in Wainwright (2013). 'Laboratory for change' became the tagline of the winning bid for the European Green Capital Award for the year 2015. As George Ferguson's vision for Bristol stated:

> 'Green' is not just about reducing emissions, energy consumption and fending off climate change. Green is a massive economic opportunity. Bristol will position itself, as China embarks on the construction of over 100 brand new cities the size of Bristol, as an exemplar model for self-sustaining and green cities the world over. The opportunities are nearly endless for us to trade on the Green Capital label.
>
> (Ferguson, 2013, p. 41)

In the early 2010s, BCC had begun amassing further capacities and resources to develop a long-term investment portfolio and experimenting at a city-wide scale, leveraging on the expertise and activities that had build-up in the city. In 2011, internal changes led to the creation of Bristol Futures, bringing together the Sustainable City Team, International Team and Digital Strategies, reflecting the pre-eminence of low-carbon and digital technologies in the city economic strategy. Meanwhile, BCC formed an Energy Services Team, with a wider remit than the EMU. This team began the preparation for setting up a municipal energy company, strengthening the links with community energy groups, and launching successful bids to larger European grants. One such grant, ELENA, allowed the Energy Services Team to establish an investment portfolio and leverage further investment. Previously, the council's initiatives had often been cash-strapped and limited to project-specific grants; now, the council had the means to develop a long-term investment strategy. Together, these developments allowed the intensification of experimentation with city-wide interventions, led by the council. In few years, the council began planning new initiatives in virtually every domain of sustainable energy (c.f. Gouldson and Millward-Hopkings, 2015; Minshull et al., 2015).

Concomitantly, the Energy Scene began to consolidate in this period. The scene now harboured a variety of organisations and activities including: many neighbourhood and place-based community groups developing small-scale schemes for energy efficiency or renewable energy; city-wide energy cooperatives developing renewable energy projects; the council-owned projects operated by the Energy Services Team; BEN operating as an umbrella organisation and CSE acting as an intermediary (Bird et al., 2013; CSE, 2011). The scene grew despite rapidly

changing policy contexts. However, this rapid expansion reinforced the sense of fragmentation, duplication of efforts, and competition between groups seeking similar support:

> We don't just have one or try it, we kind of like build on it as well, so it is this rich tapestry of grassroots projects of all sorts. It is a place where lots happen . . . sometimes too many, to the detriment of funding, and competition. And duplication. I remember arguing why are there two energy and power coops? They need two lots of legal (teams), two lots of accountants, two lots of committees. It's a bit odd really.
>
> (Interview Martin Fodor)

In effect, these groups went on to propose a Community Strategy for Energy (BEN, 2013), later endorsed by the Mayor. This strategy helped highlight the potential to develop complementarities between the grassroots and the council, and between groups operating at different scales, which is also acknowledged by city officials:

> (…) the generation side, generally works in a citywide or slightly larger scale. Because even if that is a local community centre, often the (energy) coops there might be putting solar panels on that. However, the energy efficiency side, (…) and that sort of peer-led bottom-up grassroots energy efficiency side, I think that works best at the neighbourhood level.
>
> (Interview Mark Leach)

> And they need to work in conjunction with one another (…) we are running a matchmaking service, between large business and community energy groups, so basically finding a home for solar PV. That is a citywide initiative, but then we've got the grants filtering through the community groups.
>
> (Interview Lorna Edwards)

Some of the grassroots groups benefited directly from such complementarities. The Bristol Energy Cooperative, for example, became a key partner in developing solar power in council buildings (Interview Peter Thompson). However, whereas previously BCC acted mostly as an enabler, this new settlement saw an inclination towards the direct provision of services, even in cases where the grassroots groups were already present. In 2015, the council founded Bristol Energy, a municipally owned supply company. The initiative was backed by the various political parties

in the city, in a period when budget cuts forced the local government to find new sources of revenue. The decision was also informed by the council officers' longstanding contacts with European cities with municipal companies and a growing concern with energy poverty in the city. The BCC's leadership was keenly aware of the possibilities offered by such companies, and the extent to which this could catalyse innovative ways of tackling energy poverty, reduce greenhouse gas emissions and drive investment into the city. However, given the limited experience in the UK with municipal supply companies, the project was fraught with commercial risk. Bristol Energy would have to compete against large utility companies and new suppliers, including with OVO Energy and Good Energy, two companies with strong links to the Bristol Energy Scene. As a result, the process for setting up Bristol Energy and defining its strategy was perceived by many community groups to be secretive.

> (The BCC) clearly recognise the importance of the community (…) (but this is) not the kind of open engagement that the CSE encourages in our approach to energy management. (…) we strongly endorse full consultation, very open and at very early stages (…) Whereas it seems that quite a lot has been already decided, and their tiny bits that are given away, but it doesn't give them much space for the community to get involved.
>
> (Interview Bridget Newbery)

Thus, in this settlement, the BCC has at times been perceived by community groups as being too assertive, characterising a form of 'self-righteous municipalism' (anonymous interviewee). While at times the grassroots are taken as sources of inspiration, there is also the perception that they are 'pushed aside, ignored or side-lined by an official initiative' (Interview Martin Fodor).

> There will be people who say things happen at the grassroots despite the council, sometimes they happen thanks to the council, and sometimes they happen, and they get taken over by the council, and then some of us might want to put them back in where they belong in the neighbourhoods.
>
> (Interview Martin Fodor)

Nevertheless, the co-existence, complementarity and competition between council initiatives, community-led initiates and social enterprises, generates a dynamic that reinforces expectations and forces deliberation over the framing of energy and climate strategy in the city.

> And the grassroots energy initiatives, legitimise, strengthen, reinforce, and stimulate the fact that the council is expected to be doing more, should be doing more, must be doing more, will find ways to do more. And it's not for the community to say 'you shouldn't have set up an energy company', but they will say 'we want there to be local energy, we expect there to be local energy, of course, there should be a local energy company'.
>
> (Interview Martin Fodor)

Despite the council's new-found ambitions, the long history of the alternative milieu and the recent consolidation of the energy scene, the hope for joined-up governance remains unrealised. Having departed from its countercultural beginnings informed by radical strands of the environmental movement, the alternative milieu and its energy scene have come a long way. Its objectives are, for now, entangled with new concerns, as evident in the opening words of one of the council's recent energy policy documents:

> Through further consultation and development in early 2016 it will develop into a more comprehensive plan which takes into account the action being taken across the city by a wide range of stakeholders. This will help ensure that future policy making in the area is truly 'joined-up'—avoiding duplication, capitalising on synergies and increasing investor confidence in Bristol as a global leader in city-scale action on climate change.
>
> (Minshull et al., 2015)

3.5 Discussion

3.5.1 Place-based perspective on niche formation

Considering the perspective of the local–global model, the case of Bristol would probably be understood as an instance of a broader phenomenon, its experiments representing stages in a multi-locality sequence of experiments, contributing lessons towards an emerging sociotechnical trajectory with the potential to

transform the UK's energy system. That perspective is valid if the intent is to understand national-level transitions but has shortcomings in understanding how that particular environment for experimentation evolved.

Taking seriously the observation that experimentation reflects the character of a place, and may reinforce that character, we believe that place-based accounts of niche formation are central for understanding urban transitions. With our approach, we are calling for a distinctive point of view that complements the systemic perspective. This demands attention to the multiplicity of urban experimental processes, place-specificity and multi-scalar relationships. Taking a place-based approach means considering how processes occurring at multiple scales and temporalities matter to a particular place, as our case-narrative illustrates. This requires specific analytical tools to unpack how the context is reconfigured in the long run. Here, it would be fruitful to establish a dialogue between studies attempting to identify contextual success factors (Feola and Nunes, 2014; van den Heiligenberg et al., 2017) and place-based accounts of how these factors are enacted.

Despite a growing interest in place-specific styles of experimentation, the existing literature still lacks a consistent way of characterising the patterns of experimentation and how they evolve. Analysing the actors involved, framings and complementarities, competition and coexistence between urban experimental processes (Hodson et al., 2017) was a useful first step. However, in contexts encompassing a large number of such processes, it is hard to interpret these iterations. Developing a method for characterising or mapping these patterns should facilitate comparative and longitudinal studies (see also Ehnert et al., 2018a, 2018b).

3.5.2 How Bristol became a favourable environment for experimentation with civic energy alternatives

The approach undertaken was useful in developing an understanding of how the long-term contextual reconfiguration of the alternative milieu developed an active

protective space for experimentation with civic energy alternatives, which we labelled Bristol Energy Scene. Throughout this journey, sociotechnical experimentation was taking place, but after unpacking the different settlements, patterns of experimentation and modes of governing (Table 3.2, p.118), we argue that the developments in the context did not conform to the conventional explanation of the niche formation-expressed local–global model in important ways.

First, Bristol's energy scene stemmed from reconfigurations of the alternative milieu. Since the first settlement, the anchoring of various initiatives associated with the widespread countercultural movement had begun forming a mesh of individuals, organisations and experimental processes established an institutional base in the city that influences the performance of projects embedded in it and helped enshrine sustainability in the local political agenda (Amin et al., 2002; Barnes, 2015; Brownlee, 2011; O'Doherty et al., 1999; Purdue et al., 1997). Early on, the milieu had a DIY character, but it consolidated with increasing professionalisation, experiments targeted at coordination, and concrete efforts by the local authority to support and coordinate the milieu. This enabled the generation, aggregation and retention of knowledge in the local context, building a knowledge base that included tacit knowledge gathered from multiple sociotechnical experiments, conceptual experimentation with various understandings of sustainability, and critical knowledge about the structural impediments obstructing the development of alternatives. This knowledge was sourced from local, national and international activities, but the milieu made it easy to share and retain lessons, as well as making them relevant to local concerns. Because grassroots innovations and civically minded activities could draw from this knowledge base and tap into the resources offered by intermediaries, this milieu influenced positively the performance of individual projects and increased the chances of success or survival (Longhurst, 2015). The ensuing agglomeration of initiatives was further reinforced by the inward-migration and attraction that was exerted by this well-renowned alternative milieu, as claims of cultural alterity helped in attracting and retaining countercultural and social-entrepreneurial

initiatives, and the milieu helped in sustaining alternative life-styles and ideologies (id.).

Table 3.2 Summary of the evolution of the environment for experimentation in Bristol.

Settlement	Pattern of Experimentation	Mode of Governing	Outcomes of Contextual Reconfiguration
1st 1970s—1990	Co-existing small-scale socio-technical experiments by grassroots groups with a DIY approach Complementarities in the clustering around Colston street	Enabling: tentative steps in collaboration between local government and grassroots	Vibrant grassroots activism and emergence of the alternative milieu
2nd 1990s	Social enterprises with co-existing experiments with new forms of service provision, and self-governing initiatives to reduce BCC's corporate emissions. Complementary governance experiments around sustainable development, local agenda 21 and the CREATE centre	Enabling: attempts at convening city-wide discussions about sustainable development in local agenda 21; Self-governing: measures of to reduce the BCC's energy consumption	Municipal voluntarism and consolidation of the alternative milieu
3rd c.a. 1997— c.a. 2010	Competing conceptual experimentation (peak oil, transition town, carbon control) Co-existing governance experimentation with citywide partnerships Competing attempts to develop community energy initiatives forming nascent energy scene	Enabling: BBC asserts its community leadership role, convening processes that embed climate change into council strategy, with an emphasis on carbon control and positioning the city as a green capital; Provision: first steps towards governing by provision, assessing potential for generation and developing council-owned wind turbines, and establishing Bristol Energy	Strategic Urbanism and emergence of the energy scene
4th 2010s	Competing city-wide experimentation aiming at large-scale deployment, with an emphasis on improving business models and funding schemes to deploy mature technologies at scale. Complementary experimentation at the neighbourhood level and for the establishing new grassroots initiatives. BCC attempted to develop a municipal energy utility that can potentially exploit the synergies between different kinds of community energy groups	Leveraging: BCC adopts an assertive and extrospective stance, developing an investment portfolio, municipal energy company, and enlisting the energy scene to position Bristol as a global green leader; Provision: BCC establishes a municipal energy company and seeks to expand its generation capacity	Municipal (self-)righteousness and consolidation of the energy scene

This alternative milieu, however, was not static so tracing its evolution was a crucial challenge in our analysis (Longhurst, 2013). Scrutiny reveals a variety of understandings about sustainability that informed developments in the city. These understandings were often synchronous with developments taking place at other scales, including early experimentation informed by the alternative technology movement, local agenda 21 initiatives, the transition towns movement, and discourses around peak oil which were salient in particular periods. It was only recently that constituents of this scene began articulating a shared vision for a low-carbon, decentralised energy transition in the city, but even then, multiple ideas of how to achieve this vision still co-existed. We identified distinct settlements that emerged to accommodate shifts in multi-level governance arrangements, which had implications in terms of the degree of autonomy and resourcefulness of the local government. The period from the 1970s to 2015 covers drastic changes in the governance arrangements imposed on UK cities. It is not surprising that developments in Bristol were affected, and that the passage between settlements was coupled with governance changes initiated from Westminster, given how little discretion has traditionally been afforded to English local authorities (Wilson and Game, 2006; Wollmann, 2006). However, rather than a linear process of imposing new changes from above, the case study demonstrates that accommodating or resisting these developments at the local level was also crucial. Local actors changed and reframed their activities proactively as a way of adapting to challenging institutional contexts and in order to take advantage of new structures. During the second settlement, the pattern of experimentation changed considerably, as the alternative milieu consolidated through various efforts to enable and coordinate sustainability-related activities in the city. In the third and fourth settlements, the energy scene emerged from this milieu, as a result of the institutionalisation of climate change in the local political agenda, and the direct engagement of the Bristol city council in initiating its own experiments alongside the development of community energy in Bristol and elsewhere in the UK. In each settlement, experimentation was driven by multiple framings of sustainability, which meant a constant shifting between different approaches and agendas. Hence, the formation of this scene is best understood as emerging through a

process of discontinuous contextual reconfiguration, involving multiple urban experimental processes and an array of networks that attempted to provide support to new initiatives, increase their chances of success, and facilitate collaboration (e.g., LA21, BGCP, BEN).

Second, the formation of the Bristol energy scene differs from the internal processes of niche formation: it emerged from localised path-dependencies associated with the development of the alternative milieu, constituting 'incidental protection'. Incidental is defined by the Oxford dictionary as 'happening as a minor accompaniment to something else' and 'occurring by change in connection with something else' (Stevenson, 2010). Incidental protection results from the co-location of parallel activities, as complementarities can be found in the local pool of expertise, spill overs from previous experiments, and resources that are available in the milieu. It occurs often by chance, as actors embedded in the milieu are immersed in the local buzz that is generated; activists, social entrepreneurs, city officials and (green-minded) politicians mingle in the same social circles, frequent meetings, seminars, and shared spaces (e.g., Colston Street, CREATE centre, Hamilton House). This incidental protection emerged organically over a long period and was reinforced by the co-existence of radical countercultural spaces, skilful intermediaries mediating between various interests, and organisations seeking viable business models and operating at other scales. This form of protection is crucial for the longevity and renewal of the alternative milieu. Incidental protection differs from the active or passive forms of shielding (Smith and Raven, 2012) which depend on the development of a broader institutional field that alters the selective environment and from activities associated with nourishing, it is not the outcome of purposive efforts to nourish experiments, because it is a fortuitous benefit that actors embedded in the milieu can reap by being there.

What explains the persistence of the alternative milieu in Bristol, considering that various places in the UK and elsewhere experienced the rise in environmental counter cultures and alternative milieus in the 1960s and 1970s without necessarily developing contemporary experimental settings? The importance of the grassroots

initiatives should not be overstated. As referred by a government official, there is a risk of unduly corroborating a 'sexy narrative' which attributes the greenness and radicalness of Bristol entirely to its alternative milieu. According to our analysis, this persistence derives from three place-specific, path-dependant developments:

- The emergence of multiple nationally significant professionally run environmental charities (e.g., CSE, SUSTRANS), which have their origins in the early days of the alternative milieu, and which became capable intermediaries.

- A continual reproduction of urban experimental processes within the milieu and the energy scene, which acted as sites of both contestation and collaboration, not simply increasing the performance and suitability of technologies to a particular context but instead 'culturing' plural alternatives (Stirling, 2014) and fostering the necessary conditions for their flourishing.

- The close relationship that developed between local government activities and the milieu, made possible by the 'percolation' between these activities (Emelianoff and Mor, 2013) and the acquisition of new capacities and prerogatives by the local government. This is observable in the increased participation of local government in initiating urban experimental processes, and the evolving modes of governing deployed by the local government (Table 3.2, p.118).

From the second settlement onwards, officers of the local government acting on the interface with grassroots activities were important to support, maintain and potentiate activities in the alternative milieu, providing an enabling role that helped consolidate the milieu. Since then, the rationales and priorities of the alternative milieu have been 'percolating' into the local government (Emelianoff and Mor, 2013). In the fourth settlement, however, BCC assumed a more proactive and assertive role, beyond enabling existing activities, diverging from the national trend. It expanded its activities, amassed new capacities, and created a dedicated team covering every mode of governing (Table 3.3, p.123), and managed to diversify

project funding over time with a large portfolio of activities receiving support. This was attained by leveraging the knowledge, resources and reputation accumulated in the alternative milieu and energy scene. Particularly in the last two settlements, the BCC successfully *leveraged* the local activities to position the city as a leader in sustainability and municipal energy developments. This is evident in how the vibrancy of the city's alternative milieu and energy scene is a centrepiece of the city's participation bids for international awards (e.g., European Green Capital), membership and leadership in elite trans-municipal networks (e.g., 100 Resilient Cities, C40 Climate Leadership Group, Covenant of Mayors), participation in large-scale European research projects (e.g., 7th Framework Projects, Horizon 2020), and competition over funding from national and international agencies (e.g., European Investment Bank). This strategy proved successful in a context of intercity competition over resources, where cities' accomplishments in terms of sustainability and carbon control can potentiate new investments that supposedly alleviate some of the worst effects of austerity, or help the local authority respond to the imperative of generating local economic development. However, it is also fraught with difficulties, as it involves reframing existing activities and redirecting efforts towards internationally oriented green growth strategies, which stands in sharp contrast with eco-localism rationales that inform many of the grassroots experiments found in the alternative milieu.

We argue that leveraging can be understood as a fifth mode of governing, that is salient as local authorities become increasingly proactive in an environment of inter-city competition. This mode consists of *leveraging* as local authorities promote and curate city reputations based on past achievements and successful (grassroots) experiments. This is done in order to mobilise new resources, secure participation in exclusive networks of knowledge exchange (e.g., trans-municipal networks, large-scale research projects), and access new opportunities for investments, resources and opportunities for knowledge exchange (e.g., trans-municipal networks). This mode of governing is reminiscent of 'policy boosterism' (McCann, 2013): in a macro-context of intense inter-city competition, portraying the city as a green-entrepreneurial exemplar is intertwined with leveraging urban

sustainability to attract investments and people. City-branding is central to leveraging, as local authorities rework the image and reputation of their cities, placing emphasis on their 'greenness', 'innovativeness' or alternative characters. As seen in the last settlement, promoting the city as a laboratory, is a powerful new way of exerting leveraging. Future research should engage further with exploring the political consequences of these strategies.

Table 3.3 Modes of governing associated with different teams of the local authority

Team	**Year of Establishment**	**Modes of Governing Employed**
Energy Management Unit	1994	Self-governing—handling the council's own emissions and energy consumption. Folded into the Energy Services team in 2001
Sustainable City Team	1994	Enabling and leveraging, but applied to sustainability more generally
Energy Services Team	2011	Enabling and self-governing, provision and leveraging of energy related activities, including council housing, investment in renewable energy installations, support to community energy projects, city-wide energy infrastructure development
Bristol Energy	2015	Provision: operating as an energy supply company since its creation in 2015

3.6 Conclusions

In this study, we developed a place-based approach to research the formation of a favourable environment for experimentation. Starting with the SNM's conceptualisation of the formation of protective spaces for innovation, we realised the need to consider the multiplicity of urban experimentation, the treatment of place-specificity and the coexistence of local and trans-local relationships.

To redress these issues, we conceptualise niche formation as occurring through a process of contextual reconfiguration, whereby socio-technical experiments, modes of governing and conceptions of sustainability are assembled, reconfiguring the urban context in a process that could culminate on urban transitions (Hodson et al., 2017). To examine that process in detail, we analysed different settlements,

patterns of experimentation and modes of governing. Our approach complements the systemic perspective of most transition studies and is compatible with spatialised accounts of the formation of niches in multiple localities (Fontes et al., 2016; Sengers and Raven, 2015). We argue that this approach has wider applicability for studies focusing on urban experimental spaces, the nature of how such experimental spaces emerge, and why distinctive styles of experimentation develop in some places but not others.

Through an in-depth examination of how the Bristol energy scene emerged, we emphasised the relational and contingent nature of place, in which local, national and international developments were intertwined. The alternative milieu and the energy scene are not simply a background, colourful but static, to the activities in the city.

Our account emphasised the co-evolution between urban experimentation and governance and highlighted how various actors mobilised a multiplicity of technologies, concepts and ways of governing to pursue different pathways for reconfiguring the local energy system. The meshing of these activities formed a localised concentration of organisations, practices and institutions which helped to create the cultural, material and institutional conditions for a diverse and ever-changing set of countercultural lifestyles, political identities and practical efforts to realise sustainability. Beyond the scope of our approach, other facets of the context in Bristol are likely to have influenced the emergence of energy as a matter of concern, such as the material fabric of the city (e.g., prevalence of poorly-insulated terraced houses) and wider institutional context (e.g., council ownership of social housing), for which more targeted studies might be necessary.

This milieu afforded protection to other urban experimental processes analogous to the concept of a niche as conceived by SNM. It was also a space of encounters, where community-led projects meet municipally-led investment portfolios, and where activist groups encounter professionally run social enterprises. The energy scene is the outcome of a long-term reconfiguration of this milieu, mediated by established environmental organisations, the collaboration and competition

between activities, and the engagement of the local authority. It is because of this history that it has been oriented towards civic framings of what an energy transition could be. We found no evidence of the constituents of the energy scene rallying behind a single sociotechnical trajectory; instead, those actors were attempting to mobilise elements from different trajectories to develop locally relevant solutions.

Through our case study, we identified two salient processes that influence the formation of niches in an urban context. First, the distinction between passive and active shielding that is commonly accepted in the SNM perspective obscures a third form of protection. We labelled this *incidental protection*, given that it happens as a result of co-existing activities and chance encounters by actors embedded in the milieu. This form of protection is likely to be of relevance in other cities which have an alternative milieu, or in places with strong agglomerations of entrepreneurial activity, but hard to replicate elsewhere. Second, we also learned that the local authority has developed over time a sophisticated apparatus to access various modes of governance, and most recently, the ability to do *governing by leveraging*. This mode is likely to be widespread because local authorities have been facing a heightened inter-city competition in the allocation of funds and policies. We invite other researchers to join us in investigating the political consequences of enlisting experimental environments that emerge organically to meet particular agendas.

To advance urban transitions research, we should move beyond assuming cities behave neatly as protective spaces. Cities are not undisputed launch pads for experimentation. Therefore, we call for further exploration of alternative avenues for niche formation that attend to the politics of urban transitions. It would be fruitful to complement case studies tracing a single socio-technological trajectory with cases zooming in to capture the evolution of the urban context and taking a place-based perspective. Gathering insights regarding the historical evolution of favourable environments for experimentation and synthesising them into workable heuristics should inform strategies to mobilise experimentation in favour of urban transitions. Here, we believe that typologies and taxonomies of

experimentation need to be complemented with an understanding of the 'genealogy' of experimental spaces, and comparative studies of such genealogies (c.f. Ehnert et al., 2018a, 2018b). Future work should pay due attention to the antecedents of these spaces, discern path-dependencies and place-specificities and move past static notions, such as success factors, to interrogate the dynamics and chains of events that engender different kinds of experimentation in different places. Efforts in this direction should embrace the generative potential of other dynamics beyond protection. Developing these nuanced accounts could identify the foundations on which to build effective experimental governance in particular places or inform attempts to develop place-based niches that tackle urban transitions.

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4 PAPER 2

SEEDBEDS, HARBOURS, AND BATTLEGROUNDS: ON THE ORIGINS OF FAVOURABLE ENVIRONMENTS FOR URBAN EXPERIMENTATION WITH SUSTAINABILITY

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Abstract

Urban experimentation is seen as crucial for enacting transformations towards sustainability. Research in this domain has flourished, but still lacks theoretical coherence. We review this emerging literature, combining methods for problematisation and critical interpretive synthesis, to address two questions: how does the extant literature conceive of the contexts in which experimentation emerge, and what dynamics are thought to be implicated in reconfiguring these contexts into favourable environments for urban experimentation? Traditionally, transition studies assume that cities may act as protective spaces for experimentation, but recent studies suggest other salient dynamics. We identify three lenses - seedbeds, harbours, and battlegrounds – which articulate the assumptions and dynamics associated with different understandings of the urban context. We argue for plural accounts of how urban experimentation thrives in particular places and offer a way to follow' the co-evolution between a multiplicity of experiments and their environment, through interactions between protection, connectivity, and conflict.

Keywords: urban experimentation; sustainability transitions; strategic niche management; geography of transitions; geography of experimentation.

4.1 Introduction

Urban experimentation is central to recent discourses about smart, green, resilient, and liveable cities. It is seen as a means for contending with the uncertainty and ambiguity that arise when introducing innovative technologies to the city, facing wicked problems such as climate change, or bringing about wider transformations. Proponents argue that urban experimentation can facilitate learning, catalyse innovation, promote reflexive forms of governance, and widen participation. Experiments and laboratories are proliferating quickly, as new means of governing the city. Consequently, the governance of climate change and sustainability in cities is becoming experimentalist (Bulkeley et al., 2015b; Bulkeley and Castán Broto, 2013; Hoffmann, 2011b; McGuirk et al., 2015; Swilling and Hajer, 2017). A recent scholarship highlighted widely diverse practices, framings and expectations associated with urban experimentation (Castán Broto et al., 2013; Castán Broto and Bulkeley, 2013; Evans, 2016; Evans et al., 2016; Kullman, 2013). Experiments are widely varied, and so are the attempts at characterising them (Ansell and Bartenberger, 2016; Kivimaa et al., 2017; Sengers et al., 2016; Weiland et al., 2017).

This paper aims to understand the processes involved in the formation of favourable environments for urban experimentation. Even without formally established laboratories, some places concentrate and sustain much experimentation in various domains of sustainability, infrastructure, and governance, playing a disproportional role in shaping distinct urban imaginaries (Longhurst, 2015; Raven et al., 2017b; Torrens et al., 2018; van den Heiligenberg et al., 2017). Nevertheless, there is considerable fragmentation in explanations of how this happens. To foster some theoretical coherence, this study investigates two salient questions: how the extant literature conceives of the contexts in which experimentation emerge, and what dynamics are thought to be involved in reconfiguring these contexts into favourable environments for experimentation. It also discusses their analytical and governance implications.

In particular, we problematise the tendency, within transition studies, to conflate niches and the urban context for experimentation, and to assume cities behave as

seedbeds which provide protection and resources to novel experiments (Arentsen and Bellekom, 2014; Geels, 2011b) or as laboratories where protection is supplemented with formal learning processes (Bulkeley et al., 2016; Evans and Karvonen, 2014; Karvonen and van Heur, 2014; Nevens et al., 2013). Early on, experimentation had been identified as a crucial driver for promoting system innovation and socio-technical change towards sustainability (Grin et al., 2010; Kemp et al., 1998; Loorbach et al., 2017; Markard et al., 2012; Schot et al., 1994; Sengers et al., 2016; Verheul and Vergragt, 1995). Experimentation is seen as necessary to circumvent the obduracy of existing socio-technical systems and foster path-breaking alternatives. The strategic niche management (SNM) strand of this field has been used extensively to analyse the formation of niches, conceived as protective spaces for experimentation (Schot and Geels, 2008; Smith and Raven, 2012). Developing niches has been posited as a strategy for nourishing and scaling up radical innovations with potential sustainability gains, in both social and technological domains (Hoogma et al., 2002; Kemp et al., 1998; Schot et al., 1994; Verheul and Vergragt, 1995). Similarly, the transition management strand argued for the establishment of 'transition areas', where frontrunners and researchers could envision alternatives and initiate experiments to concretise them (Nevens et al., 2013; van den Bosch and Rotmans, 2008). However recent contributions took on place-based approaches, revealing complex journeys through which places become favourable environments for experimentation emerge and develop path-dependant styles of experimentation (Longhurst, 2015; Raven et al., 2017b; Torrens et al., 2018; van den Heiligenberg et al., 2017).

We also contend that understanding urban contexts as behaving primarily as protective spaces could obscure other potentially relevant dynamics and politics (Bulkeley et al., 2014c, 2014b; Torrens et al., 2018). Other strands of work also suggest a more plural approach is necessary. For example, a geographical turn has been challenging the spatial assumptions of transitions studies (Bulkeley et al., 2011; Coenen and Truffer, 2012; Frantzeskaki et al., 2017; Hodson and Marvin, 2010; Raven et al., 2012; Wolfram et al., 2017), indicating that the formation of favourable environments for experimentation may be associated with dynamics arising from

embeddedness in territorial, sectoral, and transnational structures (Sengers et al., 2016; Truffer et al., 2015; Wieczorek et al., 2015). Others demanded more attention to the politics of experimentation, arguing that contestation is at the core of what makes experiments transformative (Bulkeley et al., 2015b; Murphy, 2015).

We therefore hypothesise that the literature already encompasses multiple conceptions of the contexts for urban experimentation, and various dynamics that influence their evolution, which are nevertheless left implicit or frequently ignored due to the lack of an encompassing framework. To redress this situation, we engage with the literature's assumptions and recurring critiques, as generative material for theoretical development (Alvesson and Sandberg, 2011). We take on this task through an iterative process of literature review and scholarly discussion.

To begin, we put forward the working definition of urban experiments that we used to orient our review and discuss the present understanding of contexts for experimentation in the transitions field. Section 4.2 outlines our methodology and analytical framework. Section 4.3 presents the results, which we articulate as three *lenses*: internally coherent set of assumptions which guide particular ways of understanding how urban contexts became favourable environments for experimentation. We label these lenses seedbeds, harbours and battlegrounds; each focus attention on plausible recurring 'contextual dynamics'. Section 4.4 presents a synthetic argument which brings these lenses together, and discusses our research questions, governance implications, and limitations of our work. We conclude by considering how to advance a plural understanding of urban experimentation in research and practice.

4.1.1 Defining urban experiments

The contemporary trend towards experimentation is a manifold and hard to delineate phenomena and so is its urban expression (Ansell and Bartenberger, 2016; Evans et al., 2016; Turnheim et al., 2018a). Not surprisingly, urban experiments have been defined variably. To guide the literature review in line with the purposes of this paper, we propose a working definition of urban experiments

that combines aspects of the conceptualisations from transitions and climate governance literatures:

- as initiatives, projects, or interventions 'delivered by or in the name of an existing or imagined urban community' (Castán Broto et al., 2013; Castán Broto and Bulkeley, 2013)
- which embody practice-based, learning-oriented, and challenge-led approaches to addressing sustainability challenges under conditions of uncertainty and ambiguity (Sengers et al., 2016)
- which involve multiple societal actors and contribute to social learning (Brown et al., 2003; Brown and Vergragt, 2008)
- and which are 'highly novel' because they differ from 'dominant, conventional ways of satisfying social needs and preferences within a specific context' (Wieczorek et al., 2015, p. 151)

In a recent review, Weiland et al. (2017) highlights that these experiments are unlike classical and natural science experiments, because they take place in real-world settings which cannot be tightly controlled, involve societal actors in initiating and caring out the experiments (necessitating co-creation or co-production, rather than only experts, see also Frantzeskaki et al., 2018), and focus on learning about what the system *ought to be* and *how to achieve* such transformation. They are best understood as attempts at developing viable socio-technical configurations, which share technological and social dimensions, 'where learning is not confined to technological learning, but includes changes in practices, services, user behaviour, institutions, ways of organising' (Wieczorek et al., 2015, p. 151). Experiments tend to emerge outside traditional channels of policy making and planning (Hoffmann, 2011c), but this is changing with many cities developing specific units or laboratories to support such activities. A variety of transdisciplinary approaches has been proposed tools to initiate, monitor and evaluate specific initiatives (Frantzeskaki et al., 2018; Luederitz et al., 2016; Raven et al., 2010). Other definitions emphasise experiments that aim at climate change

mitigation and adaptation (Castán Broto et al., 2013; Castán Broto and Bulkeley, 2013; Kivimaa et al., 2017). Here, we adopt a broader perspective as the proponents of such activities often contend with multiple challenges that are specific to the contexts in which they are being embedded and have to navigate non sustainability-oriented objectives and interests (e.g. developing novel bus-rapid transit systems addressing traffic, air-pollution, climate change, and affordability of public-transportation infrastructures, c.f. Sengers and Raven, 2015). In our view, urban experimentation is not necessarily aimed at systemic impact (e.g. grassroots innovations aimed at community empowerment) but are often enlisted in narratives about potential urban transitions or transformations. In the discussion session, we discuss the caveats of having used this working definition.

4.1.2 Contexts for urban experimentation

Within the transitions' literature, conceptualisations of the nature of experimental settings have been heavily influenced by the notion of niches and protective spaces. This literature understood niches as spaces with a distinct selection environment, which afforded temporary protection for emerging technologies, enabling learning, and technological development that deviates from the rules of a dominant socio-technical regime (Hoogma et al., 2002; Kemp et al., 1998).

Lately, with the introduction of the so called Local-Global model, there was a shift towards understanding that niches emerge from and are reinforced by learning from a sequence of experiments, in multiple localities (Geels and Raven, 2006; Smith and Raven, 2012). In this perspective, the aggregation of lessons and their articulation by intermediaries allows the development of a set of shared rules, expectations and social networks, which in turn support further initiatives; experiments and the spaces in which they thrive are linked by recursive and potentially self-reinforcing dynamics (van den Bosch and Rotmans, 2008). Accordingly, various studies approach urban experimentation from a perspective of niche formation (e.g. SNM, transition management, grassroots innovation), thus assuming that the dynamics involved in the formation of environments for

experimentation and transitions in cities are best described as part of a process of niche formation at a global/trans-local scale.

However, when considering urban experimentation, we should pay specific attention to places that concentrate experiments in multiple domains and try to understand how and why these became favourable environments for urban experimentation. Individual experiments are unlike to produce major breakthroughs in and of themselves. In urban settings, multiple socio-technical systems co-exist and intersect (Hodson et al., 2017; Schwanen, 2015) and a multiplicity of experiments have to be aligned to create sufficient momentum and arrive at robust socio-technical configurations and concrete sustainability gains. Hodson et al. (2017) for example, suggests studying how multiple sociotechnical experiments, governance arrangements and social interests are being aligned in reconfiguring the context itself. Recent studies have proposed explicitly place-based approaches to understand the evolution of specific contexts in which urban experimentation flourishes (Longhurst, 2015; Raven et al., 2017b; Torrens et al., 2018; van den Heiligenberg et al., 2017), highlighting dynamics which are not reducible to that of niche formation.

Instead of a priori conflating the urban contexts with niches, we argue that we should attend to the possibility that other dynamics, aside the formation of a protective space, are salient in the formation of favourable environments for urban experimentation.

There are also good reasons not to assume a priori that the primary loci of urban experimentation are found in protective spaces created purposively or formally instituted as laboratories. Emphasis on constructing protective spaces and setting up laboratories can lead to a neglect of situations in which urban experimentation emerge organically in a city, i.e. outside spaces designated, explicitly framed, and resourced to support experimentation. For example, when studying the development of a favourable environment for experimentation with civic energy activities in Bristol, Torrens et al. (2018) observed that political efforts to frame and equip the city as a 'laboratory for change' were a recent development in a longer

history of engagement with urban experimentation, with constant exchanges between grassroots groups and local government. While the dynamics highlighted by SNM certainly played a role in that city's developments, others were salient but downplayed by that theory.

Moreover, placing formalised experiments or laboratories in the spotlight, but neglecting unruly practices emerging from within the urban context, and the dynamics implicated in sustaining experimentation, the literature is at risk of seeing experimentation happening 'on places' rather than 'in places' (Coenen and Truffer, 2012; Hodson et al., 2015). This would imply that most cities can come to accommodate a niche or a laboratory, which is sharp contrast with the empirical domain of the literature, which has centred around places with a high concentration of urban experimentation (such as Bristol, Totnes, Fribourg, Graz, Amsterdam), which suggest that such spaces may be far from being evenly distributed. This pattern may also be the result of a bias towards studying frontrunners, which has not yet been addressed critically.

Thus, we place our conceptual focus on the urban context and the dynamics which may explain their development. To interrogate these processes, we expand on the idea that experiments and their contexts are linked by a recursive dynamic (van den Bosch and Rotmans, 2008). We define contextual dynamics as the recursive and potentially self-reinforcing processes through which the context in a city enables urban experimental processes, which in turn reconfigure or reinforce that context as to form a favourable environment for urban experimentation.

Table 4.1 Typology (adapted from Alvesson and Sandberg, 2011). *We focus on the first three categories.*

Type of assumptions	**Characteristics**	**Strategy for identification**
In-house	Assumptions that exist within a specific school of though	Scrutinising internal debates and the interfaces between groupings of related authors
Root metaphor	Broader images of a particular subject matter underlying existing literature	Identifying basic image or metaphors used to represent the social reality in question
Paradigm	Ontological, epistemological and	Requires familiarity with alternative

	methodological assumptions underlying existing literature	world views and efforts to map alterative paradigms
Ideology	Political-, moral- and gender-related assumptions underlying existing literature	n/a
Field	Assumptions about a specific subject matter that are shared across different theoretical schools	n/a

In the remainder of this article, we examine how these contexts are understood and what dynamics are implicated in the formation of favourable environments for urban experimentation.

4.2 Methodology and analytical framework

This work builds on recent investigations of contexts with a profile of persistent grassroots mobilisation (e.g. Berlin, Totnes and Bristol, see respectively Blanchet, 2015; Longhurst, 2015; Torrens et al., 2018), which exposed us to distinct understandings of why conducive environments for urban experimentation emerge. At present, no coherent theoretical position accounts for the various dynamics which were involved in shaping those contexts.

To examine that emerging body of work, we identified a method for problematising the literature and another to support the synthesis, which we present below. Both allow us to work with extant literature to identify and critique different theoretical positions and contribute towards theoretical development. Acknowledging that entrenched theoretical positions may represent specific facets of a multifaceted concrete phenomena (Sayer, 1984), we argue that articulating the distinctive understandings could sensitise researchers to take on a more encompassing view of how favourable environments for urban experimentation are formed.

4.2.1 A method for problematising the literature

We approach the nascent literature on urban experimentation with a problematisation, which we take to be a 'dialectical interrogation of one's own

familiar positions, other stances, and the domain of literature targeted for assumption challenging' (Alvesson and Sandberg, 2011, p. 252). As a research method, problematisation aims on illuminating and challenging the assumptions that underpin existing theories, opening up new avenues for research. It can be applied to different kinds of assumptions (see Table 4.1).

In this article, we focus on the in-house, root metaphors and ontological assumptions (part of paradigmatic assumptions) for two reasons. First, a focal area has emerged in recent years, and these three sets of assumptions can be seen to be in flux, and thus worthy of articulation and critical scrutiny. This is evident in how persistent emerging critiques have emerged but not been translated into full-fledged alternative theorisations. Second, because the ideology and field assumptions have been scrutinised for the wider field of sustainability transitions elsewhere (Avelino and Rotmans, 2009; Geels, 2011a, 2011b; Smith et al., 2010; Stirling, 2014).

To operationalise such problematisation, we aim at 'scrutinising internal debates and the interfaces between groupings of related authors, who use similar narratives and vocabulary', (Alvesson and Sandberg, 2011, p. 256). For that, we to use a series of guiding questions, the relevance of which can be found in previous studies (Table 4.2). We expand particularly on in-house assumptions of different groupings of the literature, because there has been substantial debate recently about these topics. Aside from contextual dynamic, which we introduced above, the other in-house assumptions have been a staple of discussions in the field. These dimensions were then used for thematic coding using Nvivo® 11 software.

Table 4.2 Analytical framework derived by expanding on the idea of problematisation.

Category of analysis	**Category in Alvesson and Sandberg (2011)**	**Guiding questions for the analysis of the grouping of papers**	**Examples of the relevance**
Root-metaphors for the context	Root metaphor	What metaphor is used to describe the urban context in its relationship with experimentation?	(Arentsen and Bellekom, 2014; Geels, 2011b; Sekulova et al., 2017)
Commonly-used context descriptors	Root metaphor	What other metaphors are used to describe the context of experimentation?	
Commonly-used process descriptors	Root metaphor	What other descriptors are used to describe the processes associated with the development of the context?	
Conception of the urban context	Paradigmatic	What is the (explicit or implicit) assumption about the constitution of the urban context?	(Longhurst, 2015; van den Heiligenberg et al., 2017)
Role played by the urban context in urban transitions	Paradigmatic	What role does the development of the urban context play in sustainability transitions?	(Hodson and Marvin, 2010; Moloney and Horne, 2015)
Contextual dynamics	In-house	Which recursive or self-reinforcing processes are thought to enable experimentation in the context and reinforce the context?	(Hoogma et al., 2002; van den Bosch and Rotmans, 2008)
Prevalent forms of knowledge and learning	In-house	What forms of knowledge and what processes of learning are foregrounded?	(Smith et al., 2016)
Role ascribed to intermediaries	In-house	What functions are intermediaries assumed to play regarding this contextual dynamic?	(Gliedt et al., 2018; Matschoss and Heiskanen, 2017)
Political dimensions	In-house	What are the central concerns regarding the politics of experimentation?	(Bulkeley et al., 2015b)
Oversights	n/a derived from persistent critiques	What critiques are levied against this perspective, in terms of what is left out or underplayed?	(Murphy, 2015; Truffer et al., 2015)

4.2.2 Identifying the relevant domain of the literature

A necessary step first for problematisation is identifying, sorting and delimiting a specific domain of the literature associated with our research question, and different groupings within this domain. Compared to research concerned with identifying and filling gaps, this typically involve a narrower literature coverage and more in-depth readings of key texts (Alvesson and Sandberg, 2011). In order to achieve this objective in a transparent and reflexive manner, we mobilise in this article a Critical Interpretive Synthesis (CIS) (Dixon-Woods et al., 2006b, 2006a). This is a method which adapts aspects of systematic literature reviews to applications where interpretation, synthesis and assumption challenging is required.

Within the social sciences, systematic reviews have been used extensively to explore particular concepts or to identify gaps that persist despite a wide range of research on a subject (Petticrew and Roberts, 2008). They are aimed towards a comprehensive treatment of the literature, with attention to the quality of the research included, a clear and systematic approach to synthesising the data, generally following a rigorous and transparent processes (Victor, 2008). This kind of review was pioneered in medicine, where they are conventionally deployed to collect evidence and test 'what works', appraised according to a strict hierarchy of evidence that privileges randomised control trials and tended to exclude other research designs and qualitative evidence (Dixon-Woods et al., 2006b, 2006a). To that objective, the method requires strictly staged protocols suited for generating an aggregative synthesis that summarises data along concepts (categories and variables) that are assumed to be 'largely pre-specified, secure and well defined' (Dixon-Woods et al., 2006a, p. 36).

In the sustainability transitions field, however, systematic reviews (Kivimaa et al., 2017; Sengers et al., 2016) have been used instead to explore and contrast understandings of particular concepts, to enable theoretical refinement and identify areas for further development. For that reason, scholars adopted more interactive procedures (rather than staged), combined with an interpretive stance

necessary to realign the reviews with the constructivist perspective on scientific knowledge (Sengers et al., 2016). Within other communities, similar concerns inspired the development of various methods for the synthesis of qualitative research (Barnett-Page and Thomas, 2009; Weed, 2005).

A review with emphasis on aggregative synthesis would not meet our interest in problematising this nascent literature, which is currently in flux, with concepts are not consistently labelled, defined and interpreted with multiple competing arguments over the conceptualisation of experimentation (Caprotti et al., 2017; Kivimaa et al., 2017; Sengers et al., 2016; Weiland et al., 2017) and equally diverse understandings over the contexts for experimentation (Longhurst, 2015; Torrens et al., 2018; van den Heiligenberg et al., 2017).

Instead, we adopt the method of critical interpretive synthesis that aims explicitly at theoretical development, circumventing some of the strictures of systematic reviews (Dixon-Woods et al., 2006b). In our understanding, CIS makes explicit the adaptations which scholars in the transitions field were already adopting. Its key processes are as follows (id., p.10):

- To start, a research question is formulated, but it may be revisited and refined
- Rather than a staged process, searching, sampling, and critique and analysis proceed iteratively, and are considered 'dynamic and mutually informing processes'
- Search is approached with a broadly defined strategy, rather than a strict protocol, and may include purposive selection of material known to be relevant
- Ongoing selection of potentially relevant sources is informed by the emerging theoretical framework, and may require additional searches
- Appraisal of sources privileges their relevance and theoretical contribution, rather than adherence to a strict hierarchy of evidence

- Procedures for extracting data may be useful but are not an essential feature

CIS complements well the notion of problematisation with an explicit method for handling the literature review. Its ideal output is the formulation of a synthesising argument which integrates the evidence from across the corpus of research into a 'coherent theoretical framework comprising a network of constructs and the relationships between them' (Dixon-Woods et al., 2006b, p. 5). This may require the generation of 'synthetic constructs' that stem from interpreting the evidence included in the review, and which mobilise various facets of the phenomenon at hand. For that, CIS invites engagement and critique with the assumptions, research traditions and meta-narratives which lay behind research reviewed. As it relies on an interpretive approach, CIS does not lend itself to full auditability and reproducibility expected of systematic reviews. Nevertheless, CIS strives for methodological transparency, embracing the authorial dimension to the research and demanding constant reflexivity by the authors of the review.

To adapt CIS to our objectives, and focus on problematisation, we carried out a search on Scopus® database for studies concerning urban experimentation with sustainability (see Appendix B, p.291 for detail on the initial searches). From this initial corpus, we identified literature reviews (n = 8), and traced their references and citations. Removing duplicates, excluding conference papers (which quality varies considerably) and screening the abstracts for relevance to our question, we limited the search to 99 entries. We then assessed the introduction of these papers, to confirm that they placed sufficient emphasis on the contexts for experimentation to justify a full-text reading. Our lead author was mainly responsible for handling the literature review, co-creating the strategy with the other co-authors and discussing intermediary results.

Finally, our interpretive synthesis was refined through dialogue with scholars in this field and feedback received in multiple conferences (Eu-SPRI 2016, IST 2017, Hamburg workshop on Urban Energy Transitions 2017, acceleration workshop in DRIFT 2018, NEST conference 2018).

4.3 Results

Below, we present the three lenses derived by approaching the extant literature with this combination of problematisation and CIS. The first part of Table 4.3 shows the root-metaphors, context and process descriptors used for grouping the studies reviewed (see also Appendix C, p.294). The second part expands on the in-house assumptions, which we explore and articulate in the coming sections. to identified three distinctive lenses, a coherent of assumptions and understandings about the nature and processes of development of favourable environments for urban experimentation, that could potentially be used to interrogate empirical cases.

Table 4.3 Lenses articulating the different assumptions encountered in the literature, based on the critical integrative synthesis.

Lens	**Seedbeds**	**Harbours**	**Battlegrounds**
Root-metaphors for the context	Evolutionary and ecological, invoking protection, separation and growth	Maritime, travel, and communication metaphors invoking mobility, flow, connectivity, communication, and cosmopolitan sensibilities	Conflict, confrontation, and performance, invoking friction, tension, and strategic action
Commonly-used context descriptors	Niche, protective space, habitat, fertile soil, breeding space, seedbed	Alternative milieu, hub, nexus, nodes, buzz, pipelines	Arenas, fields
Commonly-used process descriptors	Protecting, embedding, seeding, shielding, nourishing, nurturing, growing, replicating, scaling up, fertilizing	Harbouring, connecting, networking, migrating, anchoring, transferring, circulating	Mobilizing, resisting, struggling, gaining traction, entrenching, challenging, empowering, mediating
Conception of the urban context	A configuration of place-specific factors and resources that creates a distinctive selective environment	A hub of connections and passages, embedded in wider networks and circulations of resource, people and knowledge, which sustains a socio-cognitive milieu	An arena of disputes between political coalitions, which act strategically to advance their objectives
Role of urban context in sustainability transitions	Protect emerging socio-technical configurations, allowing them to develop and grow despite the pressure of the incumbent regime (through shielding, nurturing and empowerment)	Facilitates encounters, anchoring and (re)discoveries of various tendencies, increasing their exposure to transnational developments while offering a socio-cognitive form of protection for sub-cultures	Act as places where confrontation between incumbent and challengers are play-out, making disputes visible and allowing for the reconfiguration of governance arrangements
Contextual dynamics emphasized	Evolutionary Emerging practices, innovations and experiments are shielded from harsh selective forces, nurturing local variation and learning-by-doing	Relational Formation of a well-connected, reputable place, which draws in resources while offering exceptional socio-cognitive opportunities and protection	Institutional/Conflictive Empowerment and encounters with structural impediments Restructuring governance arrangements
Prevalent forms of knowledge and learning	Tacit knowledge from experiments being retained locally Local ecology of knowledge	Trans-local learning Access to privileged communicative channels	Learning through confrontation/ contestation (critical knowledge)

		Migration of embodied expertise	
Political dimensions	Negotiating protection Ensuring protection and negotiating resource allocations despite entrenched interests	Navigating connectivity Power relations enacted through trans-local linkages	Strategising conflict Negotiating across incongruent interests to achieve substantial institutional reforms or dislodge dominant interest
Role of intermediaries	Framing of local projects, aggregation of learning, harnessing local resources Mediating between individuals and institutions/firms	Primarily as transfer agents, connecting to global networks, harnessing resources from afar, promoting place-reputations, translating and codifying notions	Mediating confrontation and controversies, re-framing activities, building alliances, mobilizing
Key oversights	Unrealistic 'localism' of a containerised view of urban contexts Assumes a shared vision	Tensions in bringing novelty to context Who represents the milieu?	Risk of exaggerating the role of conflict in enabling transitions

4.3.1 Seedbeds

The seedbed lens foregrounds configuration of place-specific factors and resources that are thought to contribute to a selective environment conducive to experimentation by affording protection for experiments, shielding them from the harsh conditions imposed by the prevalent socio-technical regime and promoting specific processes for nurturing innovation and supporting their growth and diffusion (see Smith and Raven, 2012).

Studies in this group draw primarily from the SNM literature, referring to the context with a variety of evolutionary and ecological metaphors which emphasise protection such as niches, seedbeds, habitats, and fertile soil, and to processes which allow initiatives to be replicated, grown and spread. Similar metaphors are also present in the grassroots innovation literature, which also draws from SNM (e.g. Seyfang and Smith, 2007). Conversely, these metaphors also indicate that this protection is not absolute, as the experiments are seen to be 'exposed to the elements' of real-world contexts. To encompass both meanings but avoid conflation with the concept of niches (which has been interpreted in multiple ways), we labelled this lens as seedbeds. Fittingly, this metaphor has been used to describe the role of cities low-carbon transitions, when cities act as the initial locations for niches that go on to expand elsewhere, forming national-regimes (e.g. various niches associated with electrification), contrasted to cities not playing a part, or acting as key as agent in national level transitions (Geels, 2011b).

This lens focuses attention on how the contexts are reconfigured through the accumulation of lessons from experiments, suggesting that particular places or cities may give rise to situated 'protective spaces' for experimentation. The formation of favourable environments for urban experimentations is thought to be analogous to the formation of niches. For protection to emerge, different dynamics are at play that allows for variation to emerge, and for novel sociotechnical configurations to develop through sequences of experiments. Three key dynamics that have been summarised by Smith and Raven (2012) and cited by multiple works in this grouping.

First, the emergence of a protective space depends on shielding, which refers to processes involved in modulating the pressures exerted by mainstream selection environments (Smith and Raven, 2012). This is thought to passive shielding, where this is due to a contingent combination of favourable conditions which predates the strategic intent, and active shielding, where proponents of a certain innovation or experiment deliberately and strategically seek to create protective spaces (e.g. demonstration projects, urban laboratories, urban living labs). In the former, a growing literature has identified a series of place-specific conditions or 'success factors' which can contribute to the emergence of experiments (Feola and Nunes, 2014; Hansen and Coenen, 2015; van den Heiligenberg et al., 2017).

Second, the urban context may enhance nurturing, the processes that support the development of innovations: assisting learning, articulating expectations and for strengthening social networks (Schot and Geels, 2008). Local networks are implicated in such activities; the breadth and inclusivity of these networks is understood as a crucial factor for the development of the context. In line with the local-global model (Geels and Raven, 2006), intermediaries are seen to play a key role in framing local activities and aggregating/codifying the knowledge so that it finds wider applicability, and in creating further protection for new experiments.

A third dynamic has been identified, which concerns the empowerment of initiatives – the discursive processes through which actors involved in a given protective space argue for the wider applicability of those experiments (Smith and Raven, 2012). Here, actors may develop the competitiveness of niche (fit-and-conform) or by restructuring the wider selective environment (stretch-and-transform). In both cases, the very accumulation of experiments in a particular place may reconfigure the context as to favour further experimentation, thus creating a self-reinforcing dynamic (Hodson et al., 2017; Torrens et al., 2018).

In this understanding of the context, learning is primarily derived from practical activities (learning-by-doing) associated with introducing novel socio-technical configurations in a particular context. Whether knowledge is primarily situated or brought-in from other contexts seems to be an empirical question (c.f. Holm et al.,

2011; Schreuer et al., 2010c). According to (Heiskanen et al., 2015) there has been a tendency to neglect the knowledge accumulation that happens locally, in a 'the multi-interest' context. Along these lines, a complementary understanding can be found in studies which characterise creative cities. Cohendet et al. (2010), for example, suggests that a set of distinct organisations with different interests may, in fact, be necessary to sustain learning processes in a particular city. Based on a case of Montreal's creative milieu, they describe how a 'delicate, subtle and fragile local ecology of knowledge, where creative processes nourish themselves' (id., p.108), can emerge from the repeated exchanges between three groups: underground (i.e. artists, activists, bohemians primarily involved in exploring and experimenting with radical ideas; the upperground, i.e. companies, multinationals, concerned primarily with exploiting commercial opportunities, and the middleground, intermediaries invested in developing the local scene.

Politically, this understanding of the context highlights contention around ensuring the viability of policies supporting protection, and the allocation of resources to nourish initiatives. Also, fit-and-conform strategies for empowerment raise concern over capture, particularly when the priorities of national or municipal governments differ (Schreuer et al., 2010a), or when municipalities are seeking to support grassroots initiatives and risk overriding their priorities (Torrens et al., 2018; Wolfram, 2018a).

Two oversights justify the need for other analytical lenses. First, as pointed in recent geographical critiques, it is 'problematic to assume that 'tacit knowledge transfer is confined to local milieus whereas codified knowledge may roam the globe almost frictionless' (Bathelt et al., 2004, p. 31, cited in Sengers and Raven, 2015). This is aggravated by neglecting other non-local relationships which co-constitute the urban context (Späth and Rohracher, 2012). Second, this lens risks 'naturalising' the mechanisms through which certain interests prevail over others, depoliticising how urban contexts are mobilised and positioning as a privileged site for experimentation with particular forms of sustainable technologies and practices (Heiskanen et al., 2015). Moreover, privileging a localised dynamic of learning and creativity and emphasising consensus building downplays the

potential conflict in attempts to reconfigure the city, and masks incongruent visions of how the city ought to develop and who is to decide (Bulkeley et al., 2014a, 2014c; Hodson and Marvin, 2009, 2010).

4.3.2 Harbours

The harbour lens foregrounds urban contexts as hubs for connections, passages, mobilities and flows, acting as nodes in a wider network of cities and places, which foster diverse place-specific but connected subjectivities. Under this perspective, favourable environments for experimentation may form when places are able to draw in like-minded individuals, facilitate encounters, and enable anchoring and (re)discoveries of various tendencies. This lens emphasises that a particular city can develop multiple transnational links and become a privileged site for experimentation if it attracts, retains and facilitates the circulation of resources and embodied expertise (experts, activist, social entrepreneurs, and so forth), while at the same time offering a receptive context for ideas and concepts (including but not restricted to technology). As Blok and Tschötschel (2016) suggest, rather than emphasising the solely the fixity of metropolis, places should be seen as 'a particular nexus of situated and transnational ideas, institutions, actors, and practices that may be variously drawn together for solving particular problems' (Ong, 2011, p. 4). Regarding the prospects of transitions, places are understood variably as passage points to multi-locational innovation journeys (Sengers and Raven, 2015), members of wider cosmopolitan communities which share risks and jointly pursue opportunities (Blok and Tschötschel, 2016) or as enrolled in demonstrating the agenda of powerful transnational interests (Silver, 2017). In turn, experiments are seen to be particularly important means to reconfigure the flows or linkages, leading to potentially self-reinforcing dynamics.

Works appertaining to this group deploy a variety of geographically-informed conceptualisations, recognisable by their various maritime and travel and communication metaphors alluding to connectivity, circulation, flow, movement, transport, transmission and transnational links. Despite considerable theoretical diversity, this group is distinctive because of its reliance on relational conceptions

of place that highlight the co-constitution of situated and trans-local relationships and structures. Some of these studies draw from primarily from assemblage urbanism theories, thus inheriting both relational geographic understandings of place and flat-ontologies from actor-network theory (e.g. Blok, 2014). Implied in these accounts, is a dialectic between that which is mobile and fixed: 'mobilities cannot be described without attention to the necessary spatial, infrastructural and institutional moorings that configure and enable mobilities' (Hannam et al., 2006). Thus, to label this group, we use the metaphor of harbours, which represents places of privileged connectivity, which arise from both favourable geographical characteristics, infrastructural assets and historical developments, that are enrolled in wider networks of circulation, and which develop particular cultures as a result (e.g. multicultural, tolerant to diversity, cosmopolitan). This is not restricted to actual port cities, even if global port cities epitomise this framing (e.g. Blok and Tschötschel, 2016).

This lens focuses attention on how the contexts are reconfigured through their connectivity and exposure to other contexts. It opens research on how place-specific and proximal aspects are shaped by networks and processes 'beyond the local', through a variety of actor-, knowledge-, capital-, institutional-, and technological-transnational linkages and flows (Wieczorek et al., 2015). Two salient dynamics are salient in the literature.

First, Longhurst (2015) and Torrens et al. (2018) indicate a recurring dynamic involving cultural alterity, openness and experimentation in the formation of an alternative milieu, defined as:

> (…) a geographically localised concentration of countercultural practices, institutions and networks can create socio-cognitive 'niche' protection for sustainability experiments.
>
> (Longhurst, 2015, p. 183)

The (pre-) existence of non-mainstream identities and practices is thought to contribute to welcoming and sustaining other counter-hegemonic identities and practices. In turn, this cognitive protection and openness helps reinforce claims of

cultural alterity. This dynamic is crucial for the emergence and renewal of positive socio-spatial imaginaries (i.e. actors assume that the context is a good one for trying novel and radical ideas). Similarly, Amin et al. (2002) discussed the importance of developing and reinforcing an outward- and forward-looking sense of place, characterised by a:

> readiness to avoid a politics of place based around an inward-looking local sense of place (e.g. a culture of 'we have always done it this way', or 'our field of engagement ends at the city boundary'). Instead, we see a politics *in* place that is not reducible to a local sense *of* place, one that draws on a wider field of connections, resources, and ideas (…)
>
> (Amin et al., 2002, p. 121)

Second, a recursive dynamic involves experiments enabling or reinforcing transnational linkages, and develop place-reputations, and vice-versa. Powerful actors and often foreign actors (e.g. donors, intermediary organisations, expert networks) are particularly drawn to iconic experiments which promise to further transnational linkages and increased pull for flows of people, capital, technology (Blok, 2014). Moreover, the reputation of local institutions (e.g. grassroots exemplars, leading universities, local think-thanks, well stablished firms) and different shades of place-reputations - 'green', 'bohemian', 'creative', 'alternative', 'entrepreneurial' - which emerge organically can become prised assets which municipal governments seek to build-on and leverage (Hodson and Marvin, 2007; Torrens et al., 2018). They are crucial to attract migration of likeminded individuals and mobile experts, new knowledge, resources and capital. Increasingly, local stakeholders are engaged in quotidian efforts to shape, advertise and instrumentalise their reputations, for which sustainability activities are a prime substrate. Networks of consultants, journalists, city networks, prizes and international challenges are involved in locating, branding, ranking and celebrating 'best places',' best practices' and national exemplars (Hodson and Marvin, 2009; McCann, 2004, 2013; Ward, 2000). The active promotion by mayors and local authorities signals an 'extrospective' stance, with an 'explicitly stated global orientation that encourages both competition and cooperation with other cities for "greenest," most "liveable" status' (McCann, 2013, p. 11). Furthermore,

place-reputations may enable access to privileged communicative channels implicated in the circulation of knowledge. Building and maintaining these linkages and channels require dedicated efforts, expertise and resources which are unevenly distributed (Bathelt et al., 2004; Sengers and Raven, 2015).

Here, learning is conceptualised as happening primarily across multiple localities, and through a combination of cosmopolitan and situated ideas, designs, and interests. This highlights the process of dis-embedding, translation and re-embedding of lessons and experiences across places and scales, for which there is considerable conceptual diversity (see Blok, 2014; Geels and Raven, 2006; Sengers and Raven, 2015). It is consensual that these processes are neither automatic nor neutral politically, in the sense that what is mobilised is inflected by the interests of the actors involved in the transfer, e.g. consultants, traveling bureaucrats, mobile knowledge workers, and 'experts-cum-advocates' (Blok, 2014; Sengers and Raven, 2015; Wieczorek et al., 2015). Elsewhere, the importance of the capacity of cities to 'anchor' more global policy change has been noted (Carvalho et al., 2012).

Politically, a variety of issues ensue. Power relationships are enacted through transnational linkages, mobilities and flows, demanding attention to:

> (…) the ways in which these re-configure (or reinforce) local structures in receiving geographical contexts and how they shape the design and outcome of socio-technical trajectories
>
> (Wieczorek et al., 2015, p. 154)

Those authors illustrate that this may entail a 'partial dislocation of urban authority' face new mobile urban policy elites. Blok (2014) illustrates how models of eco-urbanism tend to be constituted through dominant strategic and commercial interests, and to be dominated by global cities 'able to exert control over critical resources in competition with more ordinary cities' (p.273). Similarly, these cities are forming 'cosmopolitan risk communities' which entail:

> new moral geographies of inclusion and exclusion (…) as certain world cities emerge as hubs in new 'green' flows of technical and policy expertise on urban sustainability'
>
> (Blok and Tschötschel, 2016, p. 720)

For cities at the margins, experiments are often initiated from 'top-down' with tightly prescribed priorities and guidelines from funding agencies and international donors, e.g. privileging private service delivery over community ownership, and thus prematurely shutting down alternative progressive or inclusive pathways (Silver, 2017). In each of these cases, studies flag that experimentation is not without contestation and conflict, which may open new spaces for politicization at the city level.

Two oversights are evident here. First, although this perspective is critical of power asymmetries associated with transnational linkages, it is less explicit about other forms of contention that arise with experimentation. Also, an emphasis on connectivity and exposure as avenues for developing favourable environments for urban experimentation places much hope for transitions on cities that are already in a privileged position and which for that reason may be those most strongly aligned with incumbent interests.

4.3.3 Battlegrounds

Finally, the battleground lens foregrounds urban contexts as arenas or fields where political contestation, struggle, cooperation are staged. This lens highlights the controversies, crisis and tensions between divergent interests, around which coalitions and social movements organise, which may or not escalate into overt conflict. It focuses attention on particular situations and events which create openings for change, rather than on the long-term development of stable structures. While still concerned with experiments, this perspective opens up the analysis to episodic contentious and unruly politics, demanding an examination of the processes implicated in the reconfiguring infrastructures or governance arrangements and how they can expedite or hinder sociotechnical change. This includes how social movements and political movements organise to resist particular developments, and clashes between distinct coalitions and alliances around particular policy decisions, e.g. between local and central governments, political parties or environmental movement and polluting industries.

This lens draws from studies that use conflict, confrontation and performance metaphors. Contexts are often described as either arenas or fields. Arenas tend to be used in conceptualisations drawing from Actor Network Theory (e.g. Jørgensen, 2012), while fields are used in conceptualisations emphasising institutional understandings (e.g. Fligstein and McAdam, 2011). These descriptors highlight an understanding of social ordering marked by a temporary, situational and actor-dependent character, with moving boundaries and new entrants, in which apparently stable situations may be destabilised by crises or surprises. Conflict is seen as generative of change, highlighting processes of building coalitions, alliances or mediation. In some cases, those metaphors convey a sense of performance (e.g. in tactical urbanism or guerrilla gardening), that capture how actors (especially social movements) may use tactics such as protests, occupations, and media campaigns to draw attention to their struggles (e.g. Jørgensen, 2012). For all these reasons, we summarise this group under the label battlegrounds.

A variety of theoretical positions are salient here. Works associated with this lens tend to dispense with the levels proposed in the multilevel perspective, favouring instead actor-centric accounts which foreground constellations of actors and their efforts for collective sense making and 'placemaking' (Håkansson, 2018; Jørgensen, 2012; Murphy, 2015). This focuses attention on how apparently powerless actors may be liberated from entrenched institutional or cognitive frames, opening up for alternative visions, interpretations, contestation and thus different courses of strategic action. Accounts of the struggles faced by grassroots and local energy initiatives (Blanchet, 2015; Fuchs and Hinderer, 2014), for example, adopt theorisations of 'strategic action fields' (Fligstein and McAdam, 2011). This conceptualisation highlights interdependence and competition between actors embedded in a 'socially constructed arenas within which actors with varying resource endowments vie for advantage' (Fligstein and McAdam, 2012, p. 3). Periods of episodic contention between actors can give way to 'settlements', periods of relative stability which re-establish collaboration and orderliness in which a dominant frame of what is at stake and what are acceptable forms of intervention become entrenched (Fligstein and McAdam, 2011).

Conflicts are thought to be both caused by and potentially generative of urban experimentation and grassroots initiatives (Blanchet, 2015; Håkansson, 2018). For example, Jørgensen (2012) highlights an instance where squatters organised a series of protests to resist the construction of a highway in Copenhagen, drawing on alliances with other sectors of the city, and ultimately derailing the plans while creating space for deliberation around alternatives to automobility. Along these lines, Murphy (2015) has called for:

> analyses of the competing place-frames associated with sustainability initiatives and the networks and actor- or institution-specific positionalities that stabilize, obstruct, and/or promote development visions.
>
> (Murphy, 2015)

One contextual dynamic regards how restructuring governance arrangements opens or forecloses the possibility of experimentation in particular directions, and vice versa. Torrens et al. (2018), for example, draws from Ward (2000) and Fligstein and McAdam (2011) to study settlements:

> (…) periods with stable constellations of actors and prevailing framings of what is at stake, resulting (…) [in] different patterns of experimentation (…) and modes of governing this activity.
>
> (Torrens et al., 2018, p. 7)

Such settlements are thought to arise from temporary standoffs between distinct coalitions of actors or between different local and national government. In contexts with multiple experiments, this may create selectivity, supporting some initiatives but curtaining others. Settlements may become entrenched through institutionalisation or might unravel through conflicts and controversies external to an environment for experimentation (see Fligstein and McAdam, 2011). One example of such a dynamic is found in McLean et al. (2016), who argue:

> (…) the 'opening up' of cities as experimental nodes is contributing to a restructuring in socio-technical urban governance, with the creation of new spaces for targeted private investment and the responsibilities of conservation efforts delegated down to an environmentally conscious citizenry.
>
> (McLean et al., 2016, p. 3246)

Another contextual dynamic regards how actors participating in conflict and confrontation may develop the capacities to act politically and increase their ability to carry out urban experimentation. This dynamic overlaps with the 'stretch-and-transform' empowerment described in the SNM literature (Smith and Raven, 2012). This concerns processes that 'create capabilities and attract resources that empower participation in political debates over the future shape of institutions and regime selection pressures' (id., p.1032). For example, when grassroots initiatives may encounter structural impediments to their objectives; being confronted with institutional misfits, economic and social structures and incumbent interests, lacking infrastructures, these actors may develop critical knowledge and political acumen about the wider structures which constrain their activities (Smith et al., 2014). Similarly, disputes over how sustainability issues are being framed (issue-frames) intractable controversies around narratives, visions or imaginaries of what a place can or ought to be (place-frames) advanced by it, may lead to the sort of societal learning often attributed to experiments themselves, challenging fundamental assumptions and spurring the search for other visions and narratives about change. Actors involved in such disputes may develop 'social skill', the ability of individual or collective actors 'for reading people and environments, framing lines of action, and mobilizing people in the service of these action 'frames'' (Fligstein and McAdam, 2011, p. 7). Skilled actors are better equipped for advancing their interests by mediating and convincing others and forming coalitions and alliances. Works in this vein challenge assumption of gradual aggregation of learning locally.

This lens places the politics of urban transitions front and centre, highlighting the struggles over the future development and questioning how experiments are enrolled in restructuring wider socio-technical governance of cities, emphasising the ambivalent character of experiments

> (…) both as a means through which to orchestrate potentially progressive and effective socio-technical change and as a means through [which] existing interests can contain the challenges of 'low-carbon' urbanism.
>
> (Bulkeley et al., 2014b, p. 1473)

Thus, the outcomes and objectives of experiments are treated as ambiguous rather than progressive. Various works highlight contestations around supposedly green urban experiments which enact neoliberal framings (e.g. Silver, 2017), or further gentrification (Håkansson, 2018). Bulkeley et al. (2014c, 2014b) proposed that it is paramount to investigate how notions of justice are articulated, practiced and contested through experiments. Without such considerations, there is a risk that incumbents may use experimentation primarily as means of socio-spatial and socio-technical control over the development of the city and the systems that compose it. Even when this is the case, however, actors involved in setting up experiments may well be aware of these dynamics and act strategically to reposition and continue to challenge incumbent structures. For example, Gopakumar (2014) highlight how experiments advancing the marketisation of water supply inadvertently help coalescing oppositional networks of activists, which go on to set up counter-experiments that embody other logics and visions.

This lens redresses important oversights of the previous lenses, but it is equally partial in focusing primarily on framing disputes and empowerment. One should avoid the pitfall of assuming binary conflicts between coalitions of local actors and non-local actors, or niche-actors and incumbents (c.f. Blanchet, 2015). Instead, the richness of this lens lies in considering how actors mobilise alliances to advance particular framings or visions. Considering whether these alliances form stable settlements avoids overemphasising conflict where there is evidence substantial collaboration and interdependence.

4.4 Synthesis and discussion

With our methodology, we sought to develop a synthetic and pluralistic approach that can support studies of the formation of favourable environments for urban experimentation. We had to balance the trade-off between two efforts: expanding our literature searches beyond the familiar remit of SNM to counter the bias towards protection and analysing the corpus to produce a meaningful problematisation. We started with ample search parameters, carried out two rounds of triage, and grouped the articles with similar root-metaphors and

apparent framings, before interpreting the different assumptions held in each of these groupings with the basis of our analytical framework (Table 4.2, p.137). This led us to outline three lenses associated with a coherent set of in-house assumptions. Taken individually, different papers rely on some of these assumptions but not others. Taken collectively, the different groupings gave as a clearer sense of the salient arguments and critiques reoccurring in the literature. These lenses could also be understood as different framings or perspectives, but that would imply they are mutually exclusive. By referring to them as lenses we hope to stress that they may be juxtaposed or combined in studying a particular context. This pluralistic approach may help researchers to be more reflexive about their implicit assumptions, and to expand the suit of dynamics they consider when studying urban experimentation.

4.4.1 How does the extant literature conceive of the favourable environments for urban experimentation?

Our results confirm the initial hypothesis that there are very distinct understandings of the urban context and the dynamics of formation of favourable environments for urban experimentation. Despite the importance of urban experimentation in current discussions about urban transformations, and numerous examples of how a multiplicity of experiments is involved in bring about such processes, few articles dealt directly with the evolution of the settings in which such experimentation occurs. The ones that did, considered place-based accounts which expanded on the notion of niches (e.g. Longhurst, 2015; Torrens et al., 2018). Nevertheless, many articles allude to the contexts for experimentation, or to theoretical concepts about these contexts, which we sought to scrutinise.

The works that informed the seedbed lens were relatively cohesive, drawing from similar sources and using a shared set of concepts that are well established in the SNM literature, an evolutionary understanding of the contextual dynamics. Many individual studies have sought to expand on SNM, suggesting conceptualising urban contexts as situated protective spaces for experimentation. We noticed a risk of overly expanding what is understood as protection, encompassing everything

that is good for experimentation. We concur with a more specific understanding of protection as in relationship to a dominant socio-technical regime (e.g. Smith and Raven, 2012) but go on to suggest that other facets of urban context also play a role in modulating the emergence of urban experimentation. We therefore argued in favour of clearly distinguishing different understandings of the context.

Both the harbours and battlegrounds lenses rely on work that is more recent, and so no singular theoretical perspective predominates (see Appendix C p.294). Overall, works associated with the harbour lens aimed at more spatially and mobility attuned accounts of urban experimentation and drew primarily from geographical traditions. Those associated with the battleground lens foregrounded actor-centred and conflict-aware accounts of urban experimentation and drew from theories such as political ecology and social movement theories. Such concerns have been addressed by a variety of social science schools, so the conceptual diversity is not surprising. Our objective here was not to reconcile such drastically different conceptions, but to make evident the different assumptions which they carry.

These lenses have distinct strengths when paired with the appropriate contexts. The seedbed lens seems appropriate in cities where urban experimentation is being driven actors embedded locally which tap into shared or at least popular visions, and where policy action to support experiments is not particularly controversial (e.g. pilot projects for electric buses developed by local consortiums and supported by local governments, local food networks founded by grassroots organisations and supported by other stakeholders).

The harbour lens is more appropriate in contexts where experimentation is driven through the mobilisation of interests, visions, and resources from elsewhere, or aimed at, for example, iconic eco-housing buildings aimed at international notoriety, eco-district developments in world port cities, development projects financed through foreign aid.

The battleground lens highlights the role of conflict, controversy and struggle in resisting or opposing particular developments, which may in turn spur

experimentation, such as protests against highway constructions followed by experiments in cycle mobility, struggles against evictions stimulating alternative visions of social housing provision.

These are obviously stylised examples which fit 'neatly' into a lens - reality is much messier. So rather than applying a lens, we suggest that analysts would benefit from interrogating situations from various angles. These lenses do not substitute theories, but nevertheless highlight certain features of a context, guiding the analysis in different directions and helping scholars problematise their own positions (Alvesson and Sandberg, 2011) or to scope different options for theoretical triangulation (Sovacool and Hess, 2017).

4.4.2 Contextual dynamics

Our analysis identified a variety of contextual dynamics associated with the development of favourable environments for experimentation, broadly associated with evolutionary, relational and institutional or conflictive understandings of how change comes about. Our approach highlights the potentially self-reinforcing characteristic of these processes. This seems pertinent given that the literature has only began to explain why particular places come to concentrate and sustain urban experimentation over extended periods.

Framing this discussion around contextual dynamics forces us to consider that contexts are constantly evolving. It draws us away from the notion of success factors which is generally static: either places have or not such factors at a given time, with little no clarity on how factors arise. Instead, our approach centred on asking how experiments co-constitute their environments, which we see as promising for research on urban transformations. It may be worthy enquire whether certain success factors are good indicators a given dynamic is in place and develop tools for assessing the development of the context.

Other dynamics might be of relevance, so we would welcome other studies exploring this space.

4.4.3 Analytical implications

For those concerned with understanding the uneven development of urban experimentation, these three lenses may form the basis for an analytical framework. Each lens identifies plausible self-reinforcing dynamics that have a strong association with particular forms of learning, intermediation and politics. This could help analysts examining why certain forms of experimentation thrive in certain places but falter in others, or why distinct patterns of experimentation are prevalent in certain periods, leading to path-dependant styles of experimentation. It would be fruitful to inquire about the effect different dynamics have on development of different kinds of experiments, and whether particular experiments require certain dynamics to thrive, or are more likely to fail under certain conditions. Our contribution is a small step towards a systematic assessment of such selectivities.

Tentatively, we suggest that places in which seedbed-like dynamics are prevalent may be conducive to experiments requiring intense practice-based learning (e.g. demanding user involvement) and adaptation to highly localised practices and preferences (e.g. eco-housing, see Holm et al., 2011) or dependent of high-degrees of trust and collaboration (e.g. energy cooperatives, community gardens). Places in which harbour-like dynamics are salient, marked by high connectivity and exposure, seem conducive to experiments that assemble multiple elements of various emerging transnational technological trajectories and which are driven by widely circulated imaginaries, such as in the case of Smart Cities (see Raven et al., 2017b). Alternatively, places with exacerbated battleground-like dynamics, with entrenched political divisions and controverted visions, may be conducive to radical social innovation but less so for technological development of the sort privileged in the seedbed-like contexts.

However, we caution against using these lenses as a typology of places, with a one-to-one correspondence between dynamics and experiments. Several of the articles reviewed highlight dynamics appertaining more than one lens, suggesting context-specific interactions. Analysts may encounter places with multiple co-occurring

dynamics. For example, Longhurst (2015) and Torrens et al. (2018) showed that inward migration associated with the growing reputation of an alternative milieu could exacerbate the sociocognitive protection in a given city and further diversify experimentation. Capturing all possible interactions is an elusive task for which to date there are no systematic studies. Instead, we invite analysts to remain attentive to the place specific expressions of these dynamics. We concur with Smith et al.'s (2016) take on different perspectives on grassroots innovation, that different perspectives and the processes they identify need to be 'in dynamic relations with one another' (p.22). When considering specific cases, it may be useful to consider whether these processes occur in sequence or simultaneously, and whether they reinforce or disrupt one another.

Whether all places can develop these dynamics, and which dynamics are most conducive to distinct patterns of experimentation seem generative questions for future studies, which could be pursued via case-studies or participatory processes.

4.4.4 Governance implications

Given the complexity of the processes involved in the formation of favourable environments for experimentation, our approach may be of help to actors involved in governing experiments in three different ways. We assume that an actor's implicit understanding of the context, and the metaphors they use when referring to it, are likely to shape particular governance responses.

Firstly, for someone involved in initiating experiments, it is important to assess what dynamics have been at play in a given context (see above), and the extent to which proposed experiments are in a good 'fit' or intentionally 'go against the grain' of organic patterns of experimentation. For example, experiments proposed from the top-down, in a context with a history of controversy may reignite conflict in a resistive way, rather than create the conditions for societal learning. We encourage those designing experiments or proposing experimental spaces to consider which forms of learning, intermediation, and politics they are seeking to stimulate. In certain circumstances, challenging established patterns of experimentation may be

useful, but this is likely to require sophisticated intermediation and careful reflexive practice.

Following from that, intermediaries and different governance actors may find this framework useful to reflect on what roles they are likely to play. It may be hard to identify when certain activities might be necessary, and what forms of learning to support, so interrogating the context with different lenses may be useful as part of a reflexive practice. This may give raise to distinctive strategies, which complement the known tools of SNM with activities targeted at developing exposure and connectivity, and for finding constructive tactics to navigate conflict, for which transdisciplinary research is needed.

Thirdly, for those involved in supporting experimentation, it may be useful to consider different avenues through which experiments may have an influence in a process of urban transformation. Not all experiments evolve into full-fledged systems which challenge existing regimes, nor into innovations that circulate widely, or new institutional arrangements. Having a plural understanding of experimentation and its relation to the context should inform forms of evaluation that are commensurate with distinct kinds of experiments and contexts.

4.4.5 Limitations of this study

Despite our efforts to adopt an expanded working definition of urban experimentation, we do not claim to be comprehensive. Our corpus focused on literature that discussed explicitly the relationship between experimentation in the urban context or that had informed directly such discussions (albeit with diverse terminologies). In hindsight, our searches found few examples on grassroots innovations, even though similar arguments are being held in that community (e.g. Smith et al., 2014). The intersections between the urban and grassroots domains deserves further attention (Håkansson, 2018; Wolfram, 2018a).

Our corpus also downplayed the specific practices involved in performing experimentation, such as the transition management's emphasis on co-creation and co-production (e.g. Frantzeskaki et al., 2018; Frantzeskaki and Rok, 2018)

debates within the sustainability science community about transdisciplinarity and experimentation (Caniglia et al., 2017; Schäpke et al., 2018). Mapping which methods of facilitation, co-creation and co-production are most appropriate to navigate the various contextual dynamics is an interesting avenue for future research.

Moreover, as the terminology in this domain of the literature is not fixed nor subject to strict convention, searches on databases are necessarily biased by the search terms used. We tried to circumvent that problem by combining different search terms and including articles citing and cited by other literature reviews (Appendix A). Still, it is possible that we missed other references covering the topic of interest. However, given that we have also inspected the references of the articles that were included in triage, and included then when relevant (see CIS) we believe that missing references would have little effect on our interpretation.

Grouping different works by using their metaphors proved to be useful but not trivial. Some articles use metaphors explicitly and reflectively, while others use them interchangeably. In the case of the seedbed's metaphor, for example, (Geels, 2011b) proposed the term when studying how cities can contribute to urban transitions, which was then adopted by various authors deploying and expanding on that idea. However, when we use the metaphor in our tables, they are derived from the grouping of papers, and not from a single study; we also used them as handles to summarise a broader set of assumptions which have a degree of internal coherence and which represent at least partially how that grouping treats urban experimentation.

Each of these groupings are not homogeneous or easily separated from the others, as the individual works that compose them draw from diverse influences and interpret core concepts from different angles (Appendix C, p.294). In various cases, articles show a degree of overlap between different dynamics and framings. We sought to move beyond discussing differences in terminology to highlight the key differences between distinct perspectives that co-exist in the literature. These are substantial because they derive from paradigmatic understandings of the nature of

the urban context and its change, and many in-house assumptions that risk being taken for granted by practitioners and scholars alike. By problematising these assumptions without attempting to provide a single synthetic approach, we hope to foster more constructive and plural understanding and debate about the formation of favourable environments for urban experimentation.

Our searches and method also downplayed the importance of the socio-material context for urban sustainability transitions, in both infrastructural (e.g. Hodson and Marvin, 2010; Rutherford and Coutard, 2014) and socio-ecological sense (e.g. Ernstson et al., 2010). It has been argued experiments require a continual remaking (Bulkeley et al., 2015b; Castán Broto et al., 2013; Castán Broto and Bulkeley, 2013). Our approach does not substitute those discussions, but hopefully helps to pluralise them in ways that support studies on the long-term evolution of the environments in which urban experimentation takes place. When considering infrastructures or socio-ecological systems, there a risk of a priori assuming which factor is determinant in enabling or constraining experimentation. For example, a city with obdurate infrastructure may still develop a context conducive to experimentation with other domains (e.g. novel business models for energy distribution, see Blanchet, 2015).

When interpreting the Harbours lens, we struggled with the fact that most of those works take on a distinct unit of analysis, focusing on transnational and cosmopolitan contexts processes, such as with multi-location trajectories and networks. We believe that dedicated studies observing how particular places are crisscrossed by multiple such trajectories would be a fruitful addition to the literature. We tried to transpose their conceptualisations and what they mean to a particular place, but that is likely to require further conceptualisation.

Moreover, any representation such as ours misses the granularity of the individual works. Each of the in-house assumptions we discussed is subject to entire strands of the literature dedicate to them, as for example, studies concerning the role of intermediaries (Gliedt et al., 2018; Hargreaves et al., 2013; Hodson et al., 2013; Hodson and Marvin, 2009). We therefore do not presume to have a heuristic that

substitutes the underlying literature. Nevertheless, when discussing this work in various conferences, we found that articulating these lenses instigated other researchers to consider alternative framings and emerging conceptualisations, and to attend to the radically diverse ways favourable environments can emerge.

4.5 Conclusion and research agenda

Our study contributes to pluralising the present debate on urban experimentation in two ways. First, we articulated different lines of argument hitherto obscured by considerable theoretical fragmentation in this domain. Second, we highlighted the emerging place-based accounts of how situated experimental settings emerge organically. By focusing on the urban context, problematising the assumptions of the literature, and trying to articulate distinct lenses, our work highlights various facets of the contexts in which urban experimentation emerge and identifies the dynamics that may explain their evolution.

The recent interest in urban experimentation has produced a growing fragmentation on the theoretical, empirical and methodological approaches, which may hinder the practical application of concepts and the critical engagement with the actually-existing forms of experimentation. By charting different lenses, we hope to facilitate theoretical advancement by clarifying the lines of argument and opening up a debate about which contextual dynamics actually shape the contexts for experimentation in particular cities.

When engaging with urban experiments, which are uncertain and sometimes risky endeavours, actors have to believe that their place is a favourable environment for experimentation or a special place worthy of their efforts (Longhurst, 2015). Understanding what motivates these practices and the different forms of learning involved should be of greater concern for the literature. It should not assume that urban experiments are being initiated over homogenous concerns over climate change, global sustainability, low-carbon transitions, or renewable energy, but instead inquire into how different worldviews and visions of sustainability are invoked in conjuring experiments, arguing for their relevance and making them

possible (Blok, 2014; Hodson et al., 2017). Which dynamics matter in a given city is both place and issue specific.

Early on, we identified the risk of overemphasising the creation of designated spaces for experimentation, either as laboratories or as strategic niches, and thus focused our efforts on exploring the dynamics involved in the organic development of experimental settings. Space being limited, we could not treat that former strand in detail. It may be fruitful to explore the discourse around laboratories and contrast their assumptions with three lenses we presented, using a similar analytical approach.

Further research should explore the applicability of the seedbeds, harbour, and battleground lenses to case-study research, empirically refining the characterisation of contextual dynamics and explore their practical consequences (Smith et al., 2014, 2016). This could involve, for example, recasting the notion of embeddedness in dynamic terms, by considering which dynamics are manifest in a context and which experiments are more likely to succeed when aligned in those situations. Understanding these different selectivities could help explain the emergence of path-dependant styles of experimentation (Raven et al., 2017b; van den Heiligenberg et al., 2017) and the challenges faced by grassroots innovations in different contexts (Wolfram, 2018a).

Our approach may be useful for those studying urban experimentation and for those involved in initiating, steering and evaluating urban experiments, pluralising their understanding of the relationship between experimentation and the urban context. Without critical reflection, current urban experimentation research may be at risk of repeating the predicament of early SNM scholars who, according to Hoogma et al. (2002), had been 'over-optimistic' about the potential of that tool to foster transitions, noting that

> the positive circles of feedback by which a technology comes into its own and escapes a technological niche are far weaker than expected and appear to take longer than expected (…) the contribution of the projects to niche development appear to be small

(Hoogma et al., 2002, p. 195)

To avoid that predicament, future research in sustainability transitions could develop strategies to map and enhance the contextual dynamics that are salient in particular socio-spatial contexts. For example, using participatory methods to discuss the history of a context and assess its evolution through different lenses could support transdisciplinary approaches aimed at harnessing urban experimentation to build urban transformative capacity.

If research on experimentation is to play a part in urban transformations towards sustainability, is paramount 'to follow' the development of the contexts in which it happens and take seriously the generative effects of interactions between protection, connectivity and conflict.

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5 PAPER 3

EXPERIMENTATION AND THE DEVELOPMENT OF TRANSFORMATIVE CAPACITY IN MEDELLÍN

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Abstract

Cities are critical junctures for efforts to bring about sustainable transformations. A better understanding of how urban stakeholders can prepare for, initiate and navigate profound systemic changes is paramount. A promising research strand involves the urban transformative capacity (UTC) framework (Wolfram 2016), which highlights various processes that need to be honed to enable capacity development. Among its components, urban experimentation has figured marginally, in contrast with the recent scholarship in that area. In this article, we bridge between those strands, to contribute to more dynamic and contextually sensitive accounts of how the formation of favourable environments for experimentation contributes to the generation and retention of UTC. The article draws from an abductive case study in Medellín (Colombia) - a reference point in global discussions about urban transformations. It shows, that protection, connectivity and conflict can shape environments that sustain multiple opportunities for 'learning by doing', 'learning from elsewhere' and 'learning by taking into account', in which experimentation can underpin the generation and retention of UTC.

Highlights

- Conceptual exploration of the contribution of urban experimentation to the development of UTC
- Abductive case study on the development of a favourable environment for experimentation in Medellín
- Dynamics of protection, connectivity and conflict, and associated forms of learning are all implicated in the generation and retention of UTC
- Discusses implications for governing the development of UTC

5.1 Introduction

Governing systemic change in cities is a pressing agenda, particularly in rapidly urbanising cities in the global south. Cities are implicated in causing, mitigating and adapting to global environmental change, and mediate how citizens experience the impacts of these processes. It is therefore crucial to understand how urban stakeholders can initiate and navigate urban transformations which can address persistent issues and reorient urban development in more inclusive, sustainable and resilient directions (Koch et al., 2017; Wolfram et al., 2017; Wolfram and Frantzeskaki, 2016).

A fruitful area of research explores the notion of 'urban transformative capacity' (UTC), defined as:

> (…) the collective ability of the stakeholders involved in urban development to conceive of, prepare for, initiate and perform path-deviant change towards sustainability within and across multiple complex systems that constitute the cities they relate to.
>
> (Wolfram, 2016, p. 126)

At present, these studies have concentrated on elucidating the processes, activities and factors which underpin these capacities (Hölscher et al., 2018). There's been only limited engagement with how capacities develop over time (Brodnik and Brown, 2018), and what role specific initiatives and experiments play (Castán Broto et al., 2018).

Examining urban experimentation more closely may offer insights into how these capacities. At present, experimentation is listed as a component of UTC (Wolfram, 2016), albeit with a limited role. In contrast, various strands of the sustainability transitions research have highlighted experiments - practice-based, learning-oriented, and challenge-led initiatives and projects - as crucial for developing radical alternatives to prevailing practices, institutions, and infrastructures (Sengers et al., 2016; Torrens et al., 2019). Path-deviant socio-technical trajectories are thought to emerge from the aggregation of learning from sequences of experiments (Geels and Raven, 2006). Hence, the early SNM literature emphasised

that initiating and protecting experiments was central to the development of niches that could support novel socio-technical configurations (Kemp et al., 1998; Schot and Geels, 2008; Smith and Raven, 2012), highlighting that cities could be 'seedbeds' for nourishing radical innovation (Geels, 2011b). Recent research also suggests that there are multiple outcomes of experimentation which if embedded could contribute to systemic change (Turnheim et al., 2018a). Crucially, experiments may play a significant role in generating and embedding capacities and confidence for change among its participants (Heiskanen and Matschoss, 2018).

This paper explores how the formation of a favourable environment for experimentation contributes to the generation and retention of transformative capacities. It begins with a conceptual discussion about the UTC and urban experimentation, with emphasis on a new strand of research that highlights how a multiplicity of urban experimental processes are involved in reconfiguring the social-material context in particular cities, in seemingly gradual but radical ways (Hodson et al., 2017; Torrens et al., 2018). We draw and extend on Torrens et al. (2019), who found distinct contextual dynamics involved in the formation of favourable environments for experimentation, beyond protection, and argued in favour of using different lenses to interrogate those processes. Places may act not only as seedbeds which protect emerging experiments, but also 'harbours' which support connectivity to other places and are capable of attracting and retaining resources, or 'battlegrounds', in which conflict and contestation are generative in the search for alternatives (id.). Each of these lenses emphasises distinct forms of learning, intermediation, and governance, in ways that better reflect the relevance of experimentation in various contexts, and which may inform dynamic accounts of the generation and retention of UTC.

This discussion builds on an abductive case study in Medellín, Colombia, which involved considerable 'back and forth' between theory and the empirical work, following the method of systematic combining (Dubois and Gadde, 2002, 2014). Medellín is undergoing a profound transformation, often referred to as the 'Miracle of Medellín', that is a reference point for many metropolitan regions in the global

south, with a string of innovative public transport interventions as a prominent element (e.g. Brand and Dávila, 2011; Dávila et al., 2013; Reimerink, 2018). This process is reshaping the city, away from its notoriety associated with narco-traffic and urban warfare (from 1980s-1990s). Maclean (2014b, 2015) remarks however that this 'miracle'

> (…) is not about the architectural and infrastructural transformations, but the long-term political changes that made it possible for the architects and engineers to build them.
>
> (Maclean, 2015b)

Our case study builds on semi-structured interviews, and recent accounts of these political processes that highlight their experimental dimension (Bahl, 2012; Simmons et al., 2018).

The paper proceeds as follows: section 5.2 discusses the literature on UTC and urban experimentation. Section 5.3 presents the method of systematic combining used in the case study, and the processes of *matching* and *redirection* through which we bridge the UTC and urban experimentation discussions. Section 5.4 presents the unfolding urban transformation in Medellín and its mobility aspects, zooming into the dynamics associated with urban experimentation and UTC. Section 5.5 discusses the results and its implications. The last section draws conclusions and points towards areas for future research.

5.2 Reconsidering the role of experimentation in the development of urban transformative capacity

5.2.1 Urban transformative capacity

Given contemporary sustainability challenges and persistent urban issues, there has been a growing interest in understanding preconditions and drivers for processes of systemic change in cities, well-documented in the literature (Koch et al., 2017; McCormick et al., 2013; Wolfram et al., 2017; Wolfram and Frantzeskaki, 2016). However, it remains a challenge to provide concrete guidance to the analysis and practice of urban transformations (Koch et al., 2017).

Addressing this issue, Wolfram (2016) proposed the notion of Urban Transformative Capacity (UTC) for examining the factors enabling urban stakeholders to initiate and perform purposeful urban transformations. He articulated an integrative framework (Figure 5.1) from a systematic review on systemic change in cities, highlighting factors that enable transformation both as a response to crises (influenced by resilience thinking), and which emerges as a result of innovation (influenced by sustainability transitions). In that interpretation, UTC is a 'qualitative measure for an emergent property that reflects attributes of urban stakeholders, their interactions and the context they are embedded in' (Wolfram, 2016, p. 126). Wolfram identified ten key components and a total of 60 factors that interact and reinforce one another in complex ways. It seeks to sensitise the analysis of systemic change to the various place-based strategies, interactions across different agency levels, and cross-scale relations which are pertinent in a particular city, helping stakeholders to recognise their strengths and weaknesses and respond strategically. Similarly, in the context of climate governance, Hölscher et al. (2018) propose to examine transformative capacity (in terms of creation, anchoring and embedding of novel approaches or solutions) and orchestrating capacity (in terms of pursuing strategic alignment between different initiatives, mediating across scales and sectors, and creating opportunity contexts).

Figure 5.1 UTC capacity framework proposed by Wolfram (2016). *Reprinted from that article with permission from Elsevier.*

The complexity of these frameworks suggests that there are multiple pathways through which capacities can develop, without a priori privileging or prescribing specific processes. Empirical research on UTC has begun grappling with the diversity of pathways possible, dependent on place-specific characteristics, actions and conjectures. For example, Wolfram (2018b), in a recent study of the UTC in three cities in Korea, coded interview data and policy documents against the (sub)components of the framework to outline the city's strengths and weaknesses and highlight areas for improvement. The evolution of these components in each city was described through brief qualitative case-studies that list chronologically how different factors developed, revealing 'rather different pathway with equally distinct governance learning dynamics involving regional, national and even international actors' (id., p.12). Similarly, Brodnik and Brown (2018) studied the UTC development in Melbourne's water management sector, examining the stakeholders' strategies. They outline three distinct phases required to 'fully

develop transformative capacity' (id., p.11): an introductory phase in which the preconditions for the introduction of new practices are developed, a diffusional phase when self-organisation processes are allowed to unfold freely, and an establishment phase when the systems conditions for the routine reproduction of new practices are achieved. As those authors highlight, however, whether those patterns are salient elsewhere remains to be seen.

In these debates, it is hard to gauge the role played by specific experiments or alternatives. Compared to other components, Wolfram's (2016) framework present little detail regarding experimentation (see Appendix D, p.299). 'Diverse community-based experimentation with disruptive solutions' (C6), together with activities for sustainability foresight (C5), is though as a means to develop 'transformational knowledge', defined as the 'practical know-how for initiating and performing radical change for sustainability (id. p.128). According to that review, experiments' systemic effects can be enhanced by four development factors:

> - Diverse experimentation is undertaken by place-based and/or issue-driven communities of practice
> - Experiments are guided by a shared vision, and by preferred scenarios/pathways (if available)
> - Experiments can deal with disruptive urban sustainability solutions, seeking to rebalance economic, social, and ecological development
> - Experiments are multi-dimensional, simultaneously addressing innovations in urban environments, cultures, institutions, governance, markets and technology
>
> (Wolfram, 2016, p. 128)

Furthermore, in a recent study that examined a database of 400 sustainability initiatives for evidence of their contributions to UTC factors, (Castán Broto et al., 2018) observed only 3% of initiatives explicitly addressing community-based experimentation (C6). They observed that 'despite an explicit orientation towards change for sustainability, transformative capacity is far from ubiquitous' (id., p.12), point out that it is 'unreasonable to expect all urban actors and initiatives to explicitly and successfully address all components simultaneously' (ibid.). Their

study highlights that UTC emerges through the relationship between specific initiatives and wider processes of institutional-and social-learning that link specific outcomes to city-wide vision of planning and development.

Compared to present debates on urban experimentation, however, the UTC framework ascribes to experimentation a muted role. As the coming sessions will show, however, research on urban experimentation indicate that a more expansive understanding of experimentation is justified, and more emphasis is needed on how multiple experiments in a same city may contribute to developing many UTC factors.

5.2.2 The expanded role of urban experimentation

There has been much interest in the notion of urban experimentation. In a growing number of cities around the world, urban stakeholders are resorting to projects and interventions which embody an experimental ethos, particularly in efforts to address climate change, further urban sustainability, and reconfigure crucial infrastructures (Bulkeley et al., 2014b; Bulkeley and Castán Broto, 2013; Hoffmann, 2011b). This trend encompasses highly diverse activities and rationales that are the subject of a growing literature (Bulkeley et al., 2015b; Evans et al., 2016; Kivimaa et al., 2017; Sengers et al., 2016; Turnheim et al., 2018a).

In these recent studies, there has been an expansion in terms of the kinds of initiatives considered as being experimental, the kinds of outcomes associated with experiments, and the processes of embedding thought to contribute towards systemic change. For those concerned with urban transitions and transformations, there's been a shift from thinking of experiments primarily as sites for testing and embedding new technologies towards treating them 'both as a particular form of governing as well as an attempt to create new political spaces' (Luque-Ayala et al., 2018, p. 30). Even though experimentation has figured in the sustainability transitions research for a long time, more research is necessary for understanding the conditions, processes and pathways which modulate the emergence of experiments and what lasting impacts they achieve (Köhler et al., 2017, p. 37).

The definition of experiments is a hotly contested topic (Ansell and Bartenberger, 2016; Caniglia et al., 2017; Evans et al., 2016; Sengers et al., 2016). In general, what the literature discerns as experiments are practice-based, challenge-led, learning-oriented initiatives or interventions which are mobilised in situations of considerable uncertainty and ambiguity (Sengers et al., 2016). Experiments tend to fall outside the traditional routines of policy making and urban development (Hoffmann, 2011a). They concern not only technological novelties, but practices, institutions and conceptions of sustainability which fall outside the norm, and hence involve not only technical learning but societal learning (Brown et al., 2003; Brown and Vergragt, 2008). *Urban* experiments are those carried out by or on behalf of urban communities (Bulkeley and Castán Broto, 2013). The extent to which experiments are formalised and clearly-bounded (in time and space) varies enormously (Turnheim et al., 2018a).

Much of the recent literature emphasises the development of experimentation in a variety of designated spaces for experimentation, such as urban living labs, transformation labs, and real-world laboratories (Bulkeley et al., 2016; Evans et al., 2015; Evans and Karvonen, 2014; Marvin et al., 2018; Voytenko et al., 2016). Early on, however, the literature recognised that the emergence of radical technologies that could be widely diffused was an uncommon phenomenon, in large part because of the miss-fit between novel socio-technical configurations and selective environments formed by entrenched rules and institutions which guide the development of a particular socio-technical system (Kemp et al., 1998; Schot et al., 1994). Hence, the SNM literature highlighted experiments as potential interventions which could be used in technological and market niches to develop those spaces further and begin carving out space for alternatives (Schot and Geels, 2008). Niches were thought primarily as protective spaces, shielding experiments from the harsh selective environment, nourishing processes of learning, network formation and alignment of expectations, and empowering particular narratives for change (Smith and Raven, 2012). Similarly, in a more guided and structured manner, the transitions management literature argued for setting up transition arenas, as spaces where frontrunners in a particular field could articulate future

visions for more sustainable systems, backcast potential pathways, and run experiments to explore multiple possibilities for accomplishing those visions (Frantzeskaki et al., 2012; Kemp et al., 2007; Loorbach, 2007; Rotmans et al., 2001). Both these strands informed recent interest in other forms of urban experimentation, and the design of urban living labs and urban transformations laboratories.

Even though such designated spaces are proliferating, experimentation in many cities is happening informally, outside such spaces, and that form of 'organic' or 'diffuse' experimentation may have cues for understanding the development of transformative capacities (Torrens et al., 2019).

5.2.3 Favourable environments for urban experimentation

Experimentation 'outside the laboratory' is also implicated in systemic change (Hodson et al., 2017; Schwanen, 2015; Torrens et al., 2018). Recently, Hodson et al. (2017) argued in favour of studying how a multiplicity of competing, coexisting and complementary socio-technical, governance and conceptual, experimental processes combine to reconfigure the socio-material context of the city. Other studies began examining the history of places which sustain vibrant experimentation over decades, observing the path-dependent styles of experimentation which ensue (Longhurst, 2015; Torrens et al., 2018; van den Heiligenberg et al., 2017).

This emerging 'place-based' or 'contextual' perspective shows that urban experimentation is implicated in various forms of learning, which may be an important avenue for the development of UTC. Rather than focusing exclusively on interventions that are explicitly framed as experimental, bounded in space and time and with formalised methods for learning, place-based or contextual approaches consider more diffuse urban experimental processes, which have relatively blurred boundaries. Here, societal learning may be an unintended consequence rather than a specific design. By not focusing solely on one specific type of experiment deemed transformative, it instead asks which forms of

experimentation are active and salient in a particular place (Hodson et al., 2017; Torrens et al., 2019).

A promising analytical strategy reconsiders the formation of favourable environments for experimentation, looking at the contextual dynamics which at once enable experimentation and are emboldened by it. Scholars in the sustainability transition tradition have for long argued that recurring dynamics connect experiments and the spaces (or niches) in which they are embedded; experiments both reshape and are enabled by these spaces (Smith and Raven, 2012; Torrens et al., 2019; van den Bosch and Rotmans, 2008).

Building on that idea, Torrens et al. (2018), developed a place-based perspective to study how a favourable environment for urban experimentation emerge on the long run. They highlighted the co-evolution between experimentation and governance arrangements and analysed the history of the emerging environment for experimentation with civic energy alternatives in Bristol as a sequence of *settlements*, periods in which actors form stable constellations and act according to prevailing framings of what is at stake (id.). These *settlements* emerge mainly due to the accommodation between local and national level interests (Ward, 2000), resulting in patterned forms of experimentation and governing, embodying distinct conceptions of what the challenges faced (e.g. sustainability). Similarly, Simmons et al. (2018), studying Medellín, argued that the emergence of informal spaces for governance experimentation (analogous to transition arenas in transition management) and their gradual institutionalisation reshaped the local governance arrangements towards a reflexive mode of governance that sparked a transition in the city's socio-economic trajectory.

However, even if the protection of experiments through niches and transition arenas are effective in sustaining experimentation and fostering UTC, this may not be the only dynamic at play, or even the most important. Torrens et al. (2019) showed that it is problematic to assume a priori that the urban context operates as a protective space for experimentation. Instead, they proposed to study the recurring relationship between experiments and contexts with a pluralistic

perspective comprising three lenses, derived from the literature (Table 5.1) Each lens articulates the learning, politics, and intermediation of urban experimentation, sensitising the analysis of how they are expressed in a particular context. For example, the seedbed lens draws attention to the processes contributing to the development of a protective space for experimentation, highlighting the accumulation of tacit knowledge developed through '*learning by doing*', while the battleground lens draws attention to conflictive dynamics which engender conceptual and governance experimentation, that can foster critical knowledge about structural challenges and institutional impediments to change. The latter is indicative a learning 'by taking into account' different perspectives (see also Callon et al., 2009), in which what's at stake are 'different ways of seeing issues - an education of attention' (McFarlane, 2011; 369). It is plausible for these different dynamics to be prevalent in different periods, or for there to be a sequence or combination (Torrens et al., 2019).

Table 5.1 Distinct understandings of how experimentation is sustained and how it contributes towards systemic change. Adapted from Torrens et al. (2019)

Lens	Seedbed	Harbour	Battleground
Conception of the urban context	A configuration of place-specific factors and resources that creates a distinctive selective environment	A hub of connections and passages, embedded in wider networks and circulations of resource, people and knowledge, which sustains a socio-cognitive milieu	An arena of disputes between political coalitions, which act strategically to advance their objectives
Role of urban context in sustainability transitions	Protect emerging socio-technical configurations, allowing them to develop and grow despite the pressure of the incumbent regime (through shielding, nurturing, and empowerment)	Facilitates encounters, anchoring and (re)discoveries of various tendencies, increasing their exposure to transnational developments while offering a socio-cognitive form of protection for sub-cultures	Act as places where confrontation between incumbent and challengers are play-out, making disputes visible and allowing for the reconfiguration of governance arrangements
Contextual dynamics emphasised	Evolutionary Emerging practices, innovations and experiments are shielded from harsh selective forces, nurturing local variation and learning-by-doing	Relational Formation of a well-connected, reputable place, which draws in resources while offering exceptional socio-cognitive opportunities and protection	Institutional/Conflictive Empowerment and encounters with structural impediments Restructuring governance arrangements
Prevalent forms of knowledge and learning	LEARNING BY DOING Tacit knowledge from experiments being retained locally Local ecology of knowledge	LEARNING FROM ELSEWHERE Trans-local learning Access to privileged communicative channels Migration of embodied expertise	LEARNING BY TAKING INTO ACCOUNT Learning through confrontation/ contestation (critical knowledge)
Political dimensions	Negotiating protection Ensuring protection and negotiating resource allocations despite entrenched interests	Navigating connectivity Power relations enacted through trans-local linkages	Strategising conflict Negotiating across incongruent interests to achieve substantial institutional reforms or dislodging dominant interest

Role of intermediaries	Framing of local projects, aggregation of learning, harnessing local resources Mediating between individuals and institutions/firms	Primarily as transfer agents, connecting to global networks, harnessing resources from afar, promoting place-reputations, translating and codifying lessons	Mediating confrontation and controversies, re-framing activities, building alliances, mobilising civil society
Key oversights	Unrealistic 'localism' of a containerised view of urban contexts Assumes a shared vision	Tensions in bringing novelty to context Who represents the milieu?	Risk of exaggerating the role of conflict in enabling transitions

5.2.4 Bridging capacities and experimentation

In the strands of the literature reviewed above, there is an initial recognition that experimentation plays a role in developing UTC, but little understanding of how capacities may arise through a multiplicity of co-occurring experiments. Bridging the discussion on UTC with a pluralistic and contextual account of urban experimentation suggests that a variety of learning processes, stimulated and sustained by the formation of a favourable environment for experimentation, are crucial for continuously generating new capacities, as widespread experimentation can contribute to multiple components of UTC.

When considering a city or place, which forms of experimentation are salient, and which processes support experimentation are empirical questions that the three lenses framework can support. Recognising that experiments are both influenced by the context and implicated in reshaping it suggests that experimentation is both the result and a source of transformative capacities. That perspective demands attention to societal learning that is diffuse, informal and distributed, as opposed to well-bounded, formalised, and concentrated in laboratories. For that reason, the analysis should attend to the processes in the context that contribute to retaining and putting to use an otherwise ephemeral knowledge.

To examine that evolution and structure our account, we adopt the notion of *settlements* (see Torrens et al., 2018). That requires considering which forms of experimentation and contextual dynamics are salient in a particular city, that are assumed to emerge from the dialectic between specific strategies pursued by the stakeholders in a given context and the concrete challenges faced locally, in an accommodation with developments at other scales. For that reason, a historical account of how the context evolved and how the stakeholders proactively sought to transform it, including but not restricted to different forms of experimentation, is an important step. However, we avoid assuming a priori this is a phased development (Brodnik and Brown, 2018).

To account for the long-term development of UTC, we unpack the contribution of experimentation to: i) The generation of transformative capacities - what processes foment experimentation and learning that can generate 'transformative knowledge' ii) The retention of transformative capacities - what processes reconfigure the context, embedding the outcomes of experimentation, e.g. by empowering a given community of practice, or institutionalising novel governance arrangements. We also examine on what efforts by the stakeholders contribute to sustain the relevant contextual dynamic.

5.3 Methodology

This article builds on a qualitative case study in Medellín, aiming for theory development. We adopt a 'systematic combining' approach to case-study research which emphasises the 'back and forth' between theorising and empirical observation (Dubois and Gadde, 2002). Rather than validating or disproving a predetermined set of claims, as it is often expected of case-study approaches (e.g. Eisenhardt, 1989; Yin, 2014) that assume a relatively linear process of hypothesis testing and an effort of generalisation through replication, systematic combining aims is to refine the theoretical framework through the confrontation with empirical observations. This approach is abductive, which requires 'placing and interpreting the original ideas about the phenomenon in the frame of a new set of ideas', a dialectical process of 'theoretical *redescription* of cases and case-study-based theory development' it' (Danermark et al., 2002). In systematic combining, such *redescription* is pursued by two intertwined processes: matching, an iterative process of fitting theory and observation and *redirection*, as the enquiry shifts to pursue the appropriate directions found through empirical research (Dubois and Gadde, 2002; see also Ragin, 1992). By making these processes explicit, the researcher can move reflexively and consider critically other perspectives which may be relevant (Dubois and Gadde, 2002, 2014). For that, the researcher has to operate with an emerging framework where concepts are used to provide guidance but remain mindful of the 'multitude of meanings' that a particular concept evokes.

Redirection, in this case, played out throughout the fieldwork and writing up process. I visited the city on three occasions, between November 2016 and July 2017, totalling three months. The first visit was primarily explorative, aimed at observing what was referred to as the 'Miracle of Medellín', a multi-dimensional transformation that had been unfolding in the city since the 1990s, and which was broadly acknowledged to have contributed to a drastic reduction in violence. I was initially drawn to the case because of the interest on the role of municipal utility companies in processes of urban transitions but was struck by accounts that emphasised the transformative leadership of a mayor (Sergio Fajardo) and the social movement from which his candidacy had emerged (Compromisso Ciudadano). That led me to the UTC framework, which acknowledged transformative leadership but placed it in a broader context. During the second visit, I was hosted by the city's innovation agency, and through a series of interviews with elite informants started recognising that various stakeholders involved in the process of transformation in the city, including insiders to that administration, were concerned how the accounts of the transformation placed too much emphasis on personal leadership, overhyping the 'miracle'. Those interviews hinted at a much more distributed, longstanding process of collective experimentation that had been initiated in the 1990s, from which Compromisso Ciudadano had emerged, which reinforced and was sustained by various shifts in the cities governance arrangements (Bahl, 2012). During the third visit, I was therefore sensitised to the need to interrogate in more detail the relationship between urban experimentation and UTC and redirected the efforts towards that. It soon became apparent that what I was observing involved the evolution of a broader supportive environment in the city, hence the shift in focus to the formation of a favourable environment for experimentation.

In turn, *matching* involved contrasting previous accounts about the evolution of governance in Medellín and the data collected during the interviews with the theoretical debates presented in the background session. I sought to engage with the extensive literature about the history of Medellín and its urban transformation and reviewed over 30 articles in English and Spanish (found via Scopus, Google

Scholar and Scielo databases). I do not attempt to reproduce another comprehensive account of the city's transformation because the unfolding transformation in Medellín has been recounted in great detail from a variety of perspectives: political economy (Hylton, 2007; Maclean, 2014, 2015a), urban environmentalism (Peter Brand, 2000), governance (Bahl, 2012) and socio-economic transitions (Simmons et al., 2018). Instead, in the spirit of *redescription*, I transpose those discussions to the understanding of UTC and experimentation, with a more circumspect case-narrative and analysis. Aside from those articles, I have also carried out a total of fifteen semi-structured interviews with elite informants (Appendix E, p.301). All but one of the interviews were in Spanish, and they were then transcribed and coded thematically. The quotes presented hereafter are translations carried out by the author. The timing of the interviews meant that many of the political actors were involved in campaigning for the national elections and were therefore reluctant to participate. Here, I benefited from oral histories and a large number of interviews that are available publicly (Devlin, 2009a, 2009b; Devlin and Chaskel, 2010). Using extensive desk research, I sought to triangulate the key events and themes. I identified professional articles (e.g. project reports from the World Bank, Inter-American Bank and UN-Habitat, reports on the prizes received by the city), newspaper articles (searches in the El Colombiano and El Tempo online databases), organisational histories ('business memory' programme from EAFIT university, c.f. EAFIT, 2017) and web pages of the various entities in the city.

To operationalise the theoretical approach discussed, the following sections:

i. Present an abbreviated summary of the main developments in the governance in Medellín, structured along three settlements describing the evolution of a favourable environment for experimentation, and with highlighted examples of the innovative processes involved.
ii. Examine how the processes of experimentation contributed to the generation and retention of transformative capacities
iii. Signposted the situations or processes for which there were signs of UTC components being developed (see criteria on Appendix D, p.299).

5.4 The evolving context for urban experimentation in Medellín

Medellín is Colombia's second largest city and is the capital of the province of Antioquia, in the northeast of the country. The urban area is composed of 16 neighbourhoods (*comunas*) which cover the central part of the of the Aburrá Valley. The city is framed by high mountains and crossed by the Medellín river. It is embedded in a conurbation in nine other municipalities that form the Metropolitan Region of the Aburrá Valley (Área Metropolitana del Valle de Aburrá, AMVA).

Founded as a gold-mining and merchant town, Medellín grew in importance in the 19th and early, 20th century as the centre for the coffee economy and subsequent industrialisation of Colombia. The local economy grew through a distinctive form of local entrepreneurialism, oligarchy and regionalism, hinged on the reinvestment of the profits of coffee exports by a handful of families which monopolised particular industrial and commercial sectors (Hylton, 2007). One of the pillars of this entrepreneurialism were municipally-owned utility companies, founded in the 1910s and 1920s and later consolidated into a multi-utility company in the 1955 (Empresas Públicas de Medellín, EPM) (Bateman et al., 2011; Mejía-Dugand et al., 2015). At the time, the city occupied the flat areas of the valley, with well-planned streets and amenities, and tram systems. The city had been planned to a degree uncommon in Latin America, supported by the visit of foreign planners and the architecture and planning departments of local universities.

5.4.1 First settlement - 1950s - 1980s

Since the 1950s, the local economy suffered intermittently from low coffee prices and increased international competition (Hylton, 2007). Nevertheless, immigration to the city continued at a fast pace, driven by the civil conflict in other parts of Colombia and the pauperisation of smallholders. The population of the metropolitan area went from around 350000 in the 1950s to over 3.5 million in, 2005, overwhelming previous planning efforts and leading to the informal

development of the steep hillsides, often in situations of risk (Bahl, 2012). 'The further away from the river and the higher up the mountain, the more inadequate living conditions are' (Garcia Ferrari et al., 2018, p. 355). Furthermore, the wealthiest in the city began concentrating in the southeast *comuna* (Poblado), which received much of the investments of the city, entrenching an intense territorial segregation that remains evident to date.

Throughout the 1980s and 1990s, the city suffered from recession and rampant violence. Abrupt liberalisation of the national economy prompted the restructuration of the local economic basis, leading to soaring unemployment (Hylton, 2007). The conflicts in this period disrupted the governing of the city (Bahl, 2012; Simmons et al., 2018). Meanwhile, the local state lacked resources, impoverished by incompetence and corruption. A form of 'illicit governance' emerged from the mutual accommodation between powerful economic actors, politicians and the 'narco' class (Maclean, 2014), further reinforced by socio-economic stagnation (Simmons et al., 2018). Compounding the situation, despite the rapid inroads towards liberalisation of the economy and international competition, the city was turned inwards, with a self-referential regionalist culture, 'it was an isolated city which saw itself as the centre of the world, but a world without connections (…)' (Interview with Françoise Coupé).

Poverty, informality, and territorial segregation compounded the lack of reach of the local state, meaning that parts of the city were off-limits to police forces and under the control of illicit actors (Maclean, 2014). The city's location was strategic, on the confluence of multiple routes for contraband, and close to areas of coca production and areas disputed by radical militias (Bahl, 2012). In a context of economic stagnation and antagonism to the leftist militias operating in the country, the growing shadow economy financed by narco-dollars was developing close-ties to sections of the traditional elite, while waging war against the state. An urban war between the Medellín Cartel, led by Pablo Escobar, and competing criminal organisations escalated the violence in the city. The poorest *comunas* were caught in the cross-fire, but the violence touched all social strata. The city became known, in this period, as the 'Murder Capital of the World'. As a result of

the violence, there was further segregation at all levels of society: 'We were all moving in separate spaces' (Interview with Alejandro Echeverri).

The scale and spread of the violence, the traumatic history of this period, and the lack of legitimacy of the local state left the city 'inviable' for a long period (Interview Jorge Perez Jaramillo). As the conflict with the cartel escalated, the state was overwhelmed and had little capacity to intervene in the city's urban development. In the mobility domain, for instance, the rapid growth of the city and the lack of institutional capacity reflected on a disorderly development of mass transportation as a patchwork of buses operated by private companies. In 1985, the municipality established, with the support of the national and provincial government, the Metro de Medellín (Empresa de Transporte Massivo del Valle de Aburrá) to build long-awaited mass-transport infrastructure along the river, in areas reserved by plans from the 1950s. Despite the intentions, the early years of the company were fraught with accusations of corruption, and substantial delays and overspending, which left the city heavily indebted.

In the steep hills, the dearth of appropriate mobility solutions meant residents had to face long commuting times and pay multiple tariffs to reach the areas of formal employment, buttressing their sense of exclusion of the city (Brand and Dávila, 2011). It was common for them to refer to their daily commutes as 'going to Medellín' (Interview with Juan Álvaro Gonzalez Vélez). As a result, in the coming periods, creating viable mobility options for these areas of the city became a crucial challenge enrolled in the effort to defuse the city violence crisis.

During the first settlement, the city faced a series of crises which overwhelmed the administration, stifling experimentation, and hindering the development of UTC. The local government was also hindered by an overall lack of legitimacy. The administration had limited capacities for governing the day-to-day of the city, let alone the transforming it. Nevertheless, Simmons et al. (2018) argued that 'these governance arrangements and the desperation of many citizens at all levels of the city created a desire to change both to governance structures and the material

circumstances of the poorest' (p.241), which 'planted the seeds' for renewing the city.

5.4.2 Second settlement - 1990s

In the early 1990s, in response to the violence and legitimacy crisis, the Colombian state underwent profound changes to the institutional structure, establishing a supportive institutional basis that facilitated the mobilisation of civil society and created openings for governance experimentation in the city (Bahl, 2012; Maclean, 2014). These shifts were supported by the local economic elite, whose interests were threatened by the emergent narco-class and the loss of influence to Bogotá (Franz, 2017). These reforms aimed to dislodge some of the clientelist links which had dominated the politics until then, inspired by the 'good governance' agenda of the World Bank. They were underpinned by changes to public management that brought forward a form of technocratic government. First, from 1986 onwards, the direct election of mayors was established, allowing for new leaders to emerge which were not aligned to either the two parties that dominated Colombian politics until then. Second, in 1991, a new constitution promoted decentralisation, equipping provinces and municipalities with new mandates and the ability to raise more taxes. Third, despite a drive for privation in 1994, and the neoliberal undermining of the reforms of this period, EPM retained municipal-ownership, albeit with an independent board. The Metro company finally concluded the construction of the first line which was inaugurated in 1995.

The reforms were profound, initiating a shift in the governance of large Colombian cities, albeit with mixed results. In Bogotá, Colombia's capital, the reforms had an immediate effect allowing for the election of independent mayor, which were now empowered (to the point of becoming 'emperors') well-resourced with the ability to raise local taxes, and creating the conditions for the emboldening of a community of practice around planning and urban design (Berney, 2010; Gilbert, 2006). In Medellín, however, these effects were delayed by a second cycle of violence erupted in the confrontation between urban militias and the Colombian state and paramilitaries (Bernal Franco and Navas Caputo, 2013; Hylton, 2007).

In this period, experimentation was primarily driven by a battleground dynamic, where the crisis was being contested over multiple fronts that created multiple spaces for participation generative for conceptual and governance experimentation (Bahl, 2012). The 1991-1995 Special presidential commission (Consejeria Presidential) was established with the aim of coordinating central and local government interventions and created multiple spaces for civic participation and consultation that placed a premium on dialogue and encounter between citizens, officials and politicians across the city. As Simmons et al. (2018) remarks, 'citizens found new informal governance spaces in the midst of a crisis to pursue socio-economic transition and interrupt the process and cycles of violence' (p. 245). Those authors note that these spaces were analogous to transition arenas, where frontrunners in different domains were gathering to envision and propose new approaches to defusing the conflict, including urbanism, mobility, environmentalism, education, and support to popular culture. These spaces allowed for discussion around the causes, effects and possible solutions for the complex crises faced by the city, as well as the formulation of a widespread narrative for change, raising *system awareness* (C4).

> The urban challenge was defined in terms of reconstruction of peaceful coexistence and collective interest, requiring renewed values, social sensibilities and spatial symbols
>
> (Brand and Thomas, 2005, p. 213)

Moreover, in those spaces, new links and avenues for collaboration (C1) were being forged between universities, private sector, and organised civil society, giving rise to new institutional arrangements that formalised participation (e.g. participatory budgeting, neighbourhood fora, planning councils where representatives of different neighbourhoods had a say) (Simmons et al., 2018)

> If there is a fundament of the transformation in Medellín, it is the social capacity that was generated [through the participative processes in the 1990s]. The same society was charged with rethinking itself to get out of the crisis (…) and it decided to adapt itself, to rethink itself, and to learn how to transform itself (…) This transformation of Medellín is not a matter of a political decision, nor of an urban project. It is a social decision which derived into processes of planning, political processes and urban projects'
>
> (Interview with Juan Manuel Patiño Marin).

A landmark programme for urban regeneration epitomises this period. PRIMED (Programa Integral de Mejoramiento de Barrios Subnormales en Medellín, Integral Program for Subnormal District Improvement in Medellín), was carried out with the support of the Un-Habitat and co-financed by the German Development Agency and the Colombian Government. It sought to develop holistic forms of intervention in the most deprived areas of the city, with a territorial focus, and a multi-disciplinary integration. Besides concrete objectives about the improvement of living conditions, the programme aimed at regaining territorial control and re-establishing state legitimacy in the affected communities (González Escobar, 2011). PRIMED fell short of its targets of regeneration and legalisation of informal settlements but offered multiple opportunities to learn about how to engage with the population of informal settlements, how to articulate multiple state interventions, all of which influenced the following period.

Box 5.1 PRIMED, the Integral Program for improving sub-normal neighbourhoods

Universities engaged closely in those two processes and became an early protected space for socio-technical and conceptual experimentation, with early signs of a seedbed-like dynamics. That helped form a generation of scholars, architects and planners which 'cut their teeth' in experiments carried out as part of that programme, many of whom were part of a transdisciplinary group at the Universidad Bolivariana (Taller de Estudios y Proyectos del Norte). International experts from Europe and Latin America were frequently invited to give workshops (Webb, 2011). The then Dean of the University, Jorge Perez Jaramillo, was himself a young planner involved in these processes:

> During the social crisis of the 1990s, we understood that the School (…) had to formulate alternatives for the future of the city and the society at large. (…) The School turned itself into a sort of laboratory, a place of great experimentation! Which made possible that a whole generation of architects grew with a strong commitment to public issues, and with a great operational capacity to intervene upon the city. (…) We were putting together a sort of jazz band and constructing the School as a jam session: a collective movement, yet very compact, that discussed and constructed everything together. Dozens of young professors grew up in this way (…), and those same professors were later to be the very actors which greatly influenced the urban transformation of Medellín.
>
> (interview with Jorge Pérez Jaramillo in Torino and Hernández, 2018)

In regard to mobility, the Metro company became central to the purpose of integrating territories and thus critical for defusing the crisis in violence (Brand and Dávila, 2011). In the second settlement, the inauguration of the first two metro lines prompted efforts to ensure the appropriation of that infrastructure by the population and legitimation of the company, after the delays and cost-overruns which had mired the project. The company sought to develop a new civic culture, labelled Cultura Metro through campaigns that instilled a set of rules and attitudes users were expected to abide by when using the system. These efforts create a distinctive experience of inhabiting the public space, developed through series of educational activities aimed at inducing citizens to a new mode of transport. The metro, with impeccably clean stations and silent, well-behaved users, became a celebrated symbol of a new type public space, reinforcing a sense of ownership and pride about the infrastructure (Álvarez Correa, 2015; Loaiza Bran, 2015). However, at the same time, these initiatives were analogous to experiments, in that they thought taught employees of the company new sensibilities about how to conduct 'social management' (gestión social) of infrastructure projects that was crucial for *embedding innovations* (C7) later on (interview Juan Álvaro Gonzalez Vélez).

In this period, a variety of participatory spaces generated processes of co-responsibility with the population, with citizens increasingly involved in different phases of planning, design and execution of the integrated urban projects being

pursued. These spaces created multiple opportunities for transdisciplinary engagements in that supported for *societal learning* and *reflection* (C8) and contributed to the development of *system awareness* (C4) regarding the structural determinants of violence. Much of the societal the learning developed during this period, was synthesised in the Strategic Plan of Medellín (published in 1997, covering the period until, 2015), and in a tacit 'collective agreement and civic commitment' (Interview with Jorge Perez Jaramillo), a 'radically new vision' centred around 'infrastructure projects; conspicuous investment in poorer areas; development of public space; participation.' (Simmons et al., 2018, p. 245). However, the interruption of PRIMED, and complacency of the traditional political class drove many of the participants of these informal spaces to coalesce around a new political movement, Compromisso Ciudadano ('Civic Commitment') that emerged in new participatory spaces, bringing together academics, community leaders, and conscious business leaders. These formed part of an emerging 'reflexive middle class' (Maclean, 2014) that was engaged and concerned with redressing the issues of the city, and from which a new generation of political leaders with transformative aims and the ability to mobilise the different sectors of the city (C2).

To sum up, in the second settlement, as the city responded to its crisis in violence, contextual dynamics associated with the battleground lens were prevalent, with early signs of a seedbed dynamics in regard to the local universities. Critical exogenous developments opened up spaces for a variety of governance and conceptual experiments *involving inclusive and reflexive forms urban development and governing* (C1) (Simmons et al., 2018). Those spaces were as much about citizenship and democracy as they were about specific solutions for the city, and fostered *learning by taking into account* the perspectives of a wider section of the population, while also mobilising an emerging 'reflexive middle class' (Maclean, 2014). Those experiments contributed to the generation of capacities by establishing new governance arrangements and foster new narratives about the city, with a new sensibility in the public administration about how to address the

needs of marginalised communities and to embed innovations. That period was reminiscent of Amin's claim about the 'good city' where:

> (…) new voices can emerge, the disempowered can stake a claim, the powerful can cease to hold free rein, and the future can be made through a *politics of engagement* rather than a *politics of the plan*.
>
> (Amin, 2006, pp. 1018–19).

5.4.3 Third Settlement - 2000s - 2015

In the early, 2000s, Medellín was beginning to renew itself and recover from violence and debt. Violence started to subside with the defeat of the urban militias and the demobilisation of the paramilitaries, but the fiscal situation was dire (Gutiérrez S. et al., 2011). The city was becoming a *seedbed* for innovative approaches to urbanism and mobility, premised on the emergence of transformative leadership, a new guiding vision and a robust institutional environment. Concomitantly, the city also displayed *harbour-like* dynamic that further supported but also changed the character of the experimentation and the development of UTC, as the administration became invested in boosting the reputation of the city through iconic interventions, prizes and events, connecting the city to transnational circuits of knowledge production about urbanism and mobility.

Transformational leadership (C2) was epitomised by Sergio Fajardo, a Fajardo, a mathematics professor who led Compromisso Ciudadano ran for mayor as an independent, building on the mobilisation of the previous decade. He lost the election in, 2000 to Luiz Perez (Liberal Party) but was elected for the, 2004-2007 cycle, breaking with the dominance of traditional parties. He and his successor, Alonzo Salazar (2008-2011) drew heavily from the ranks of those which had participated and lead experimentation in the previous period, renewing the leadership of the public administration and embedding new organisational routines that emphasised clarity of purpose, honesty, transparency, and accountability (Devlin and Chaskel, 2010). This movement managed to mobilise support from various sectors while also avoiding direct conflicts with established

political forces in the city council and other levels of government. To a large extent, subsequent administration by Anibal Gaviria (liberal party, 2012-2015) built on and further developed these achievements. For that reason, we threat this period as one settlement (see also Bahl, 2012; Simmons et al., 2018).

Under Fajardo and Salazar, urban development was being framed by a *vision* for (C4) 'social urbanism' (Echeverri et al., 2011), drawing on experimentation from the previous period, and from similar experiences in Barcelona and Bogotá (Brand, 2013). This new narrative emphasised holistic interventions concentrated in territories that previously had been neglected and disconnected from the fabric of the city, premised on the need for social investment: the poorest communities were due 'a social debt' which the city could pay by investing in high quality educational facilities, libraries, public spaces and infrastructure. That process integrated large iconic buildings and infrastructures (e.g. library parks, bridges) with small-scale 'porous' architectural interventions specified in closer collaboration with communities. PUIs (Proyectos Urbanos Integrales, integrated urban projects) instantiated social urbanism, with interventions that were

> (…) partly functional (improving the provision of and access to services and improving quality of life indices) but above all aesthetic: high quality architecture and finishing aimed to materialise the idea of inclusion.
>
> (Brand, 2013, p. 4)

The emergency in the communities involved, and the response through PUIs established a specific form of 'planning experimentation', associated with 'a mode of emergency planning that turns areas of intervention into spaces of exception from city ordinances and governance arrangements' (Sotomayor, 2015, p. iii). Under the administration of Anibal Gaviria, social urbanism was reframed as 'civic pedagogical urbanism', that placed more emphasis on multiple large-scale city-wide interventions such as a greenbelt for containing the upwards growth in the hills and the revitalising of the city's river banks. Integrated urban development projects continued under a new label UVAs (*Unidades de Vida Integrada*) albeit with more limited resources and different criteria for allocation. Proponents saw

in this shift a necessary adaptation to planning the city strategically to deal with the structural socio-economic problems, instead of scattering of PUIs across the city (Interviews with Jorge Perez Jaramillo and Margarita Angél).

A crucial link between experimentation and the UTC became evident during those administrations. On the one hand, *protection* for 'strategic projects' was provided by a robust institutional environment, which created space for new organisational routines and rationales to be put to practice while also supporting the *retention of the learning-by-doing and from-elsewhere* that emerged as a result. The municipal companies - EPM, Metro and EDU (Empresa de Desarollo Urbano) - became key actors the unfolding transformation of the city, operating with considerable autonomy, financial stability, technical capacity (Bahl, 2012; Coupé et al., 2013; Varela, 2010). They were enrolled in conceiving and carrying out PUIs, and used

> (...) to inculcate solidarity and build a new civic culture based on mutual respect for what government can do, matched to what private citizens should feel responsible for.
>
> (Bateman et al., 2011, p. 2)

Given the history Medellín and its crises, the administration was expected and willing to pursue bold approaches to achieve social impacts, even when there was uncertainty about financial viability (Interview with Viviana Tobón Jaramillo). Moreover, the projects were carefully planned and implemented by a specific governance arrangement, in which EDU implement the projects with direct oversight from a special team of young project managers within the Mayor's office (Devlin, 2009a). The planning system and its metropolitan region was professionalising and becoming less susceptible to partisan meddling and was staffed by academics and experienced professionals that had been formed by the previous decade of experimentation, many of whom maintained the link to academia. For example, Alejandro Echeverri, a leading architect that had been central to conceptualising social urbanism, and who had practical experience working in the poorest communities in the north-west of the city, was appointed as general manager of EDU (2004-2005) and director of Urban Projects in the municipality (2005-2008).

As a result of that protection, planners and architects were emerging as an emboldened *community of practice*, who were given freedom to design innovative and daring projects that could symbolise the unfolding transformation of the city. Since the administration of Luis Perez, and particularly that of Fajardo, the city established a track record of high-profile architecture and infrastructural projects (mostly delivered by either EDU and Metro and funded by EPM). These successes increased the confidence of municipal government in its ability to deliver complex integrated projects in increasing scale and pace, even when using technologies considered novel in that context (e.g. metrocable, see Box 5.2). At the same time, the 'thick' organisational environment offered opportunities for professionals to move between various branches of the public sector, the municipality, the metropolitan area, or the provincial government (see Appendix E,p.301). For example, managers formed in the Metro company in the 1990s went on to lead EDU after, 2008, caring with them the learning about the inception of the metrocable and Cultura Metro (Interview with Margarita Angél). The combination of internal mobility of professionals between different branches of government, and the joint work in complex projects, meant that learning happening in each of the different organisation and the capacities developed as a result were being diffused and spread across the administration. Moreover, many of these professionals continued teaching in the local universities, as part or full-time professors, and were thus implicated in forming a new generation of professionals and helping to consolidate a *community of practice (C3)* with good understanding of the issues and practical engagements with the neighbourhood in most need. The public bodies, municipally-owned companies and that community of practice were effective in retaining UTC, even in the absence of formalised learning processes.

> (…) It was an experience that was not well documented, and not formal. There was more trial-and-error, which allowed us to learn. (…) AMVA has a technical team that stayed over time. That has allowed us to capitalise on that learning; of course, there are always changes in the directive posts, which change with the administrative cycles, but there is a very good basis of human capital, which is what maintained the historical perspective and memory. (…) In themes of mobility, there was no formalised mechanism for transferring knowledge. There has been performance that is intuitive, experimental, which we have been capitalising.
>
> (Interview Viviana Tobon Jaramillo)

Aerial cable-car and public library in informal settlement in Comuna 1 (Photo: Julio Dávila, Creative Commons Licence)

The early development of the city *Metrocables* (Cable-cars, sometimes referred to as cable-propelled transit, CPTs, or aerial ropeway transit, ART) in *Comuna* 1, in the northwest of the city. This notorious project has been widely reported (Acevedo-Bohórquez, 2012; Brand and Dávila, 2011; Dávila et al., 2013; Fearnadez Milan and Creutzig, 2017; Leibler and Brand, 2012). Here, we highlight their experimental dimensions.

The inception of Metro Cables required considerable socio-technical experimentation, as Metro engineers had to design a bespoke system to the local

topographic and social conditions of the city's northeast hills. A group of the company's engineers travelled the world to learn from multiple examples (from ski stations in Switzerland to the Ivory Coast), to conceive preliminary designs briefs. Their design combined the machinery of traditional mountain cable cars with the pillars of the Madeira Island that narrow foundations more suitable for densely urbanised areas (Interview Margarita Angél). After a period of internal development, the METRO company had then to enlist foreign contractors to build the systems, many of which refused to get involved in such a high-risk project. Nevertheless, the project received continued political commitment by Mayor Luis Perez (2000-2003). Despite initial opposition, project was later embraced and upgraded by the Fajardo administration, which recast it into the social urbanism approach, adding articulation with other urbanist interventions (PUI) and an educational/cultural agenda, as an award-winning library built on the same hill and financed by the king of Spain (which has since been mired by problems in the façade and is undergoing reconstruction).

Moreover, the employees of the Metro company had to learn how to co-develop the project with the marginalised communities, who after many years of informality, violence and struggles with the law were deeply sceptical of the benevolence of the state. This involved, for example, the close work of sociologists which were responsible learning about the appropriate language, and ways of approaching and engaging the community as to ensure their sense of ownership dignity, while also finding ways for regularising land rights and relocating the households whose houses stood on the way of the planned line (Interview with Juan Álvaro Gonzalez Vélez). As the project neared completion, further experimentation was also crucial to induce users to the system, who had to develop specific competencies specific to this mode of transport (Brand and Dávila, 2011). Surrounding the new transport links, EDU co-developed with the communities an PUI that helped embedding the cable-car station in the territory. The cost of which 'exceeded by a factor of six the cost of building the cable-car system itself' and was further supplemented by small business promotion programmes (id., pp. 657-8)

Since the first line of metro cable (Line K, in the northeast, inaugurated in, 2004), new lines are created in rapid succession (J, in, 2008, L in, 2010, H, in, 2016, and M, currently under construction). Ever since, similar aerial cable-car systems have been constructed in informal settlements of various Latin American cities, including Rio de Janeiro, Caracas and La Paz.

Box 5.2 Metro Cables, the city most notorious mobility innovation

That institutional environment was reinforced by a series of intermediary organisations, regionalist collaboration and ties between private sector, public bodies and academia forged in response to the crisis. These intermediaries worked in alignment with the municipal administration, contributing with the articulation of shared visions, the development of supportive networks, and the aggregations of lessons. These included a monthly forum between representatives of local universities, business leaders and the local state (forum Universidad-Empresa-

Estado), and an organisation dedicated to monitoring the development of the city (Medellín Cómo Vamos) and business advocacy groups (Pro Antioquia).

Another example of the fruits of this protective and connected environment is EnCicla) the city's free bike sharing scheme without advertisement. Developed since, 2010 as a graduation project three students of EAFIT (a private university), the project was presented to the city council and taken up and funded by AMVA as a pilot project, and rapidly scaled as a free service integrated with the city's public transport infrastructure (interview Viviana Tobon Jaramillo and Jorge Perez Jaramillo, c.f.). The scheme is a small part of a surge of interest around cycling in Medellín, which now has a myriad of cycling collectives and cycling advocacy groups (Interview with Carlos Cadena, c.f. Escudero and Uribe, 2016). In, 2015, the municipality and metropolitan area committed to building a cycling infrastructure, formalised in a metropolitan plan for cycling (AMVA, 2015) and further integrated the system with the public transportation, aiming to expand the EnCicla to reach all municipalities in the valley, from 50 to 530 stations, and extend the use of cycling from 0.7% to 10% of the total travels. In the same year, despite the small contribution of cycling to the cities present transportation matrix, the city's commitment to supporting cycling was widely advertised when it hosted the World Bicycle Forum, the world's largest cycling related event.

Box 5.3 EnCicla, the system of public bikes of the Aburrá Valley

In this period, Medellín began displaying dynamics associated with the Harbour lens, capitalising on its new-found reputation as an exemplar of urban transformation and good governance. Medellín struck a chord with international organisations and development agencies which projected onto it expectations about finding a 'model' for urban transformations in the Global South. It's remarkable story, in contrast with the notoriety of the cities cartels' and its fame as 'murder capital of the world', became a well-known case in the development sector, featured in reports by the Intermerican Development Bank, World Bank, UN-Habitat. Through a dedicated International Development Agency, the administration was actively pursuing foreign direct investment, bidding for prizes and for membership professional networks (in urbanism and mobility), with support of its business associations that reaffirmed the regionalist pride of bygone eras. It's PUI's and iconic building received various architectural and urbanism awards(Ellis Calvin, 2014, pp. 70–73), such as the, 2016 Lee Quan Yun prize and the 'the most innovative city' completion held by the Wall Street Journal and The Urban Land Institute (the city beat the other finalists, New York and Tel Aviv, on

an online vote). In this context, the prevailing isolationism began to subside (Interview Françoise Coupé). The story of cities transformation became widely shared by media outlets, professional publications, grey literature of international organisations, where it occupied the symbolic place once reserved to 'model' cities such as Curitiba (Brazil) and Bogotá, drawing in a growing number of tourists and visiting students and researchers from elite architecture and planning schools. This newly found reputation placed Medellín in a prominent position in global circuits of knowledge exchange about urbanism and development (e.g. UN-Habitat, World Resources Institute's Embark Network, Rockefeller Foundation's 100 Resilient Cities Programme). In the mobility sector, this manifested with the development of capacities to anchor innovations from elsewhere, and to mobilise resources to reform its infrastructure along the lines of previous experiments. Aside the Metrocable, the city's mass transport system also includes Bus Rapid Transit and Tramway lines. The Metro company has been engaging in increasingly large infrastructural projects funded by foreign development agencies, which praise the company's sound finances and track record of projects delivered on schedule and on budget. The Acucho tramline, from example, inaugurated in, 2017, was partially funded by a 250 Million USD loan by the French Development Agency. However, instead of being a recipient of help, Medellín it is now portrayed and recognised as a 'model of best practice', and a 'laboratory'. As advertised by the director of its international development agency:

> Medellín, which recognises its achievements and its lingering challenges, understands itself nowadays as a laboratory of creative public policies, projects and strategies, and is starting to feel prepared to share with its sister cities its learning and, in equal manner, to receive from theirs. Hence, the city seeks to transcend the dynamic of international cooperation carried out thus far, to initiate itself in the south-south cooperation (…)
>
> (Alcaldía de Medellín, 2011, p. 21)

However, with increasing emphasis on image over substance, the city is at the risk of 'losing the narrative' of social urbanism drifted, as remarked by one of its key proponents in a local-newspaper column.

> Foreign visitors, experts, politicians, students, in quantities never seen, come convinced they will find here the answers to their city. That in Medellín they will discover the miraculous model (…) Them, the visitors, are more convinced than ourselves (…) Paradoxically, walking the city and talking to its people (…) telling us that our city is forgetting the human urbanism, that the avidity for flashes and for images is above people. Those that lead local processes (…) always complain to us that the urbanism with a social angle does not exist in the city. (…) And what we see makes us think this is true, because we have come to such extremes that the city is caricaturing itself.
>
> (Echeverri, 2015)

Another striking example is the second PUI, in *Comuna* 13, where the EDU built a series of electric escalators aimed at connecting the steep hill to the rest of the city. The community in this area had suffered, in the early, 2000s, from a traumatic open conflict between the FARC and forces from the Colombian State and Paramilitary forces. As a mobility intervention, the escalators have been evaluated as 'extravagant solutions for an ill-defined problem' that meets the transportation need of a small section of the inhabitants in the area (Reimerink, 2018). Nevertheless, the area became an icon of the city's transformations, as the local community of street artists made the surroundings of the stairs into an open gallery of Graffiti that is the object of many guided tours. The large numbers of tourists attracted to the area are a pressing reminder of the new international image of the city.

Box 5.4 The escalators in Comuna 13

To summarise, in this settlement contextual dynamics associated with the seedbed and harbour lenses became prevalent. Three consecutive administrations incorporated many of insights from the previous period, shaping a robust institutional environment that was supportive of experimentation, guided by the rationale of 'social urbanism' as narrative for the city and mobilising various sectors. That power accelerated the renewal of the city governance arrangements, and the put into action a myriad of strategic projects with an implicit experimental streak that were effective in creating visible signs of change in the city and brining about important reconfigurations in the local infrastructure. Comparatively, state-led socio-technical experimentation partially displaced governance and conceptual experimentation of the previous period. Mobility experiments, in particular, became more relevant, as the Metro company developed its technical, financial and managerial capacity, and became a strategic actor in territorial

integration, as a central element of integrated urban projects. The growing technical capacity of the administration and its municipally owned companies meant that 'bureaucracy was substituted by technocracy' (Interview with Juan Manuel Patiño Marin). As the city reputation grew, catering to that reputation grew in importance, with a shift in priority towards expert-led, iconic interventions that could sustain the international reputation. Thus, there is a risk of displacing the *politics of engagement* of the previous period, returning to the *politics of the plan*, or advancing in the *politics of acclaim* (see also Reimerink, 2018). As Medellín becomes increasingly committed with promoting the success of its 'model', it may, in fact, be jeopardising the very conditions which brought about a democratic and urbanistic renewal to the city.

> (…) Medellín's model of urban restructuring conveys the city's ambivalent aspirations of becoming, on the one hand, more democratic, equitable and inclusive through redistributional infrastructure and anti-poverty programs, and on the other hand, a better fit for attracting foreign capital investment through the internationalisation of an emblematic experience of resurgence.
>
> (Sotomayor, 2015, p. 221)

5.5 Discussion

Understanding how urban stakeholders can develop the capacities for initiating and conducting transformations is a pressing question, to which the UTC framework offer a rich analytical language. This article foregrounded urban experimentation, and in particular, of the formation a favourable environment for experimentation, as a way to explore the long-term development of UTC. At present, there is a tension between identifying enabling factors (as in UTC) and observing dynamics (as with the three lenses), which this article has begun bridging.

Whether an initiative is experimental is not only dependent on the initiatives characteristics, but also on the context in which it arises. It matters whether initiatives are framed within a wider challenge-led and consultative processes, in a context which facilitates learning (formally or informally), an in 'spaces of

exception' justified by emergencies. In such circumstances, 'strategic projects', 'strategic plans' and other such initiatives that emerge outside established institutional routines of government can create outcomes analogous to more conventionally defined experiments. As the case study illustrates, not all projects which generate considerable learning are framed explicitly as experiments, nor are they part of well-established experimental settings such as laboratories. In Medellín, this organic, diffuse form of experimentation was a major component of the unfolding transformation of the city and was supported by the rationale of social urbanism and a challenge-led approach which inspired an open-ended search for multiple elements which may be missing and that need to be developed. It is in that sense that the city became a favourable environment for experimentation.

The implication for analysts is that, by choosing to study single experiments, especially iconic ones, and framing evaluative processes around these well bounded initiatives, researchers risk neglecting more emergent, distributed outcomes that are nevertheless transformative (Heiskanen and Matschoss, 2018). This finding corroborates calls for research that focuses on urban experimental processes happening outside laboratories (Hodson et al., 2017; Torrens et al., 2018), but also demands more attention to the place-specific configurations and governance arrangements which support learning (e.g. Lenhart et al., 2014) That perspective on urban experimentation is more compatible with the UTC framework and its emphasis on emergent, distributed capacities.

Experimentation understood in this way had an important but changing contribution to the development of various components of UTC. It emerged as a dialectical response to the challenges of the city, and so its character changed over time, concomitantly with the evolution of a favourable environment. That process was not gradual, as there were periods with distinct forms of experimentation and governance (see also Bahl, 2012; Simmons et al., 2018). This corroborates Torrens et al. (2018) observations about the formation of a favourable environment for experimentation, and Brodnik and Brown (2018) observation of the 'phased' development of UTC. Using the notion of settlements to conceptualise these

different periods was useful and provided a basis for *redescription* of previous accounts on the unfolding transformation in that city. Three settlements are relevant here (see Table 5.2). That analysis emphasises how the groundwork for the transformation that became visible in the early, 2000s had begun earlier on, in diffuse processes of experimentation that contributed to the emergence of an empowered community of practice, the rekindling of the governance arrangements, and the development of new visions for the city. Attributing these processes to specific projects is hard, as they emerge from a combination of a variety of activities. At present, the issue of how actors become aware and committed and who is able to mobilise distributed capacities is underexplored. Heiskanen and Matschoss (2018) suggest that the participation in successful experiments may contribute to the developing a sense of confidence and capacity that can 'radiate' in the context. More research is necessary regarding this question. The case in Medellín suggests that transformative leadership and community mobilising had an activating role, revealing and harnessing latent capacities in the city, shaping its purpose and a sense of direction with new narratives about the city's potential. That activating role could explain why the transformation of the city seems from the outside abrupt or 'miraculous', when in effect the preconditions had been developing over a decade and involving many more actors.

Table 5.2 Summary of the different settlements and their implications to the experimentation with mobility

Settlement	Exogenous developments contributing to establishment of the settlement	Characteristics of the settlement	Prevalent contextual dynamics and implications for experimentation in mobility
1st 1950s-1990s	Rapid migration to the city. Violent conflict in Colombia and later in Medellín Loss of revenues from coffee exports Liberalisation of the economy and local economic crisis	Illicit governance (Bahl, 2012) and Economic Stagnation (Simmons, 2018). Municipal administration and planning system overwhelmed by the rapid growth of the city. Local state disempowered and unable to cope with demands. Eruption of violent conflict with drug cartels.	Disruption to both experimentation and the development of UTC
2nd 1990 - c.a., 2000	1986 Mayors elected directly 1991 New constitution devolves power to the city 1991 Special council for the city is appointed 1992 Death of Pablo Escobar 1994 Liberalisation of the utilities (without privatisation)	Governance Experimentation (Bahl, 2012) and the establishment of the basis for a more competitive socio-economic system (Simmons, 2018) Eruption of violent conflict with urban militias. Formation of a critical generation of architects and planners committed to working in the city	Prevalence of battleground-like dynamics, early signs of seedbed-like dynamics Considerable conceptual and governance experimentation around new forms of thinking urbanism and facilitating participation Focus on the development of organisational basis and public transport infrastructure. Metro company established and first line inaugurated. Development of the 'Cultura Metro'
3rd 2000-2015	2002 Demobilisation of Paramilitary forces agreed with national level 2003 Election of Sergio Fajardo	Governance Renown (Bahl, 2012) and the development of an urban renewal regime (Simmons, 2018) Restored legitimacy of the city	Prevalence of seedbed and harbour-like dynamics Social urbanism as the primary rationale for intervention, but with shifting priorities. Mobility interventions as part of integrated urban projects.

	administration, strengthening of the institutional basis and development of the	Socio-technical experimentation with mobility options among an empowered community of practice (engineers, architects and planners in municipal companies and planning department) Renown of the city facilitating transnational projects through development finance and recruitment of international experts. Tendency towards iconic interventions

The environments in which experimentation flourishes are a better locus to understand the development of UTC than individual initiatives or projects, which necessarily are focused and partial (Castán Broto et al., 2018). The case indicates that, in places where a favourable environment for experimentation is forming, experimentation contribute to both generating and retaining UTC, with combined outcomes that exceed the objectives of individual projects (Heiskanen and Matschoss, 2018). As discussed earlier, the UTC literature has thus far considered a limited role for experimentation, focusing primarily in its role of creating disruptive socio-technical alternatives, and neglecting the multiplicity of experiments and avenues for learning they afford. Focusing on favourable environments reveals that they contribute directly to transformative knowledge, with contextual dynamics that sustain a multiplicity of experiments and various forms of learning (by doing, from elsewhere, and by taking into account).

These dynamics also support the reconfiguration of organisations, institutions and governance arrangements that allow for the retention of capacities over time. In

Table 5.3, we expand the three lenses approach to capture these processes, and their contributions to the various components of UTC. Tentatively, the table also notes the stakeholder's efforts that sustain the different contextual dynamics.

Based on these findings, we propose that considerations about the contextual dynamics be integrated in the assessment of UTC, using the three lenses approach. Stakeholders can use that approach to identify which contextual dynamics are already present and which require more work, and design interventions accordingly. This could be part of a diagnostic of their environments for experimentation, mapping the ongoing activities, and questioning which are the basis for generating and retaining capacities. For instance, an intermediary agency such as 'Medellín Como Vamos' could organise workshops with stakeholders involved with urban experimentation, to elicit the status of the environment for experimentation. After reflection, participants could then identify which efforts to prioritise, aiming to reinforce the relevant dynamics or balance them out.

Table 5.3 Unpacking the generation and retention of UTC using the three lenses approach

Lens	**Seedbed**	**Harbour**	**Battleground**
Form of learning contributing to transformative knowledge	Learning by doing	Learning from elsewhere	Learning by taking into account
Generation of UTC: Processes which foment experimentation and learning	Multiplicity of socio-technical experiments, creating practical opportunities for learning by doing and the development of technical capacities and the development of potentially disruptive socio-technical configurations (C6).	Multiplicity of experiments involving trans-local relationships, forging collaboration and creating opportunities for trans-local learning that increase the ability to anchor innovations and resources from elsewhere (C7)	Multiplicity of conceptual and governance experiments which open spaces of participation and 'hybrid forums', allowing learning through deliberation and contestation, and the development of *reflexivity (C8)*, new sensibilities, and a shared narrative about the crisis/conflict
Retention of UTC: What processes reconfigure the context embedding the outcomes of experimentation	Formation of a *community of practice* (C3) that allows for the retention of professionals with tacit knowledge, and the development of distinct organisational routines	Formation of organisational and institutional structures that sustain *trans-local linkages* (C10), allowing actors to access privileged channels of communication and attract resources	Formation of governance arrangements that secure participation (C1) and empower different actor groups to stake claims about the unfolding transformations
What efforts by the stakeholders sustain the relevant contextual dynamic?	Efforts to initiate and fund new experiments, broaden social networks, aligning expectations to create shared visions (as per Strategic Niche Management)	Efforts to promote the city's reputation, and seek experience and expertise from other contexts, e.g. through hosting international events, biding for prizes and establishment of international collaborations	Efforts to convene participation beyond the bureaucratic and technocratic sphere, allowing different voices come to the fore reframing the problem and the search for solutions (Mcfarlane, 2011)

This case also shows how multiple contextual dynamics are interrelated. In the second settlement, a battleground-like dynamics preceded and was generative of the seedbed and harbour -like dynamics (involving protection of experiments and connectivity to other contexts, respectively). '*Learning by taking into account*' (Battleground) was very prevalent in the 1990s, with early signs of protection and learn by doing around the universities (Seedbed). In the third settlement, learning-by-doing (Seedbed) and learning-from-elsewhere (Harbour) played a more important role, with a strong involvement of the municipal companies and agencies. Interestingly, only recently an explicitly experimental narrative emerged in the city, which has been posteriori framed as a laboratory for change and a source of best practices, as part of the effort to promote the city internationally. However, that period also suggests that the harbour dynamic may be disruptive, in that the efforts for promoting inclusive urban transformations can become entangled with city branding and green boosterism (see Torrens et al., 2019), creating an ambivalence which is prone to capture by entrenched interests (Sotomayor, 2015). At present, given the hype about urban experimentation, there is a risk that experiments will become associated with the 'planners pride' producing 'eye-catching, prestigious' interventions aimed at an transnational audience instead of addressing the genuine needs of populations (Reimerink, 2018), particularly in cities of the global-south. It is paramount to monitor not only the learning outcomes of experiments, but also the shifting motives which underpin them, and develop evaluative and participative tools in support of reflexive practice.

Hence, the diagnostic proposed above may also warn stakeholders about which interventions to avoid. For example, in a context displaying clear signs of contestation and conflict, proposing new experiments that are perceived as superfluous and that do not acknowledge the contending perspectives is likely to further entrench oppositions, shutting down the generative possibilities of learning by taking into account.

Finally, experiments in a particular domain (e.g. mobility) have to be considered as multi-dimensional and happening in conjunction with other experiments happening in that place, as part of the wider transformation of the city. As with the metrocable example, a multiplicity of experimental interventions in different domains combine to form a particular solution with systemic impacts. What developed as a successful mobility solution required changes to urban planning, formalisation of housing rules, and new approaches for community mobilising. The city had been grappling with different approaches to address informal neighbourhoods concomitantly with the efforts to develop the new mobility system, both which were crucial for developing the metrocables as a viable alternative.

5.5.1 Limitation of this study

On hindsight, a potential conceptual limitation regards the blurring of what counts as experimental. We adopted a relatively loose definition, which allowed us to explore how experimentation changed over time, revealing how, under the right contexts, traditional projects and initiatives may produce outcomes analogous to experiments. However, we warn against attributing all forms of systemic change to experimentation, either by using an overly encompassing definition of what an experiment is or attributing to experiments all potentially transformative outcomes. Clearer frameworks for evaluation are needed to mitigate this risk, discerning what experiments and conventional projects achieve (Turnheim et al., 2018a).

A methodological difficulty was found when applying the contextual perspective of experimentation with a case study, concerning the level of detail used to describe at once the changes in the context, the development of UTC, and the contribution of specific experiments. Future research would benefit from participatory approaches for developing such narratives. For example, it may be fruitful to adapt the innovation history method, to convene workshops where

stakeholders are asked to co-construct the history of particular innovations or experiments, to examine the history of experimentation in a city and identify the effective or deficient components of UTC, prioritising the most salient actions, and highlighting where there are consensus and disagreements.

The present study is by no means a comprehensive assessment UTC of Medellín, nor a complete account of its unfolding transformation, which is a vast and multifaceted enterprise. We drew, whenever possible, from the rich literature on that process. Poverty, exclusion and territorial segregation are still prevalent in Medellín, and it impossible to establish 'how much' capacity development would be enough to redress these issues. Too few empirical cases have explored this space, so it is unclear which components and factors are necessary, let alone sufficient, to initiate and navigate urban transformations.

However, the development of urban experimentation and UTC can provide insights into the means for governing processes of urban transformation. As the case illustrates, the development of UTC is a highly contextual specific process, for which there are many possible pathways. In effect, the formation of a favourable environment for experimentation that sustains organic experimentation is probably just one such pathway. For that reason, we make an only tentative argument about how these environments can be enhanced. Ultimately, the challenges faced are not static, and the political processes not predictable, so these discussions are useful if they can facilitate reflexion about the processes at hand.

This study is also not an evaluation of the impacts and outputs of different experiments beyond the formation of capacities, nor the continuity of that process after, 2015. The interviews involved elite informants involved in the processes, but not the communities affected by those interventions. Specific evaluations covering those aspects can be found elsewhere (e.g. Reimerink, 2018). For the same reason, the account presented may have downplayed the participation of grassroots movements involved in the transformation of the city. Their influence is most salient in individual projects, but less so at the wider contextual level which was our core focus.

5.6 Conclusions

This study explored the contribution of favourable environments for urban experimentation to the development of UTC. That aspect had been downplayed because experiments have been primarily considered in isolation, and thus assumed to generate outcomes that are narrow and ephemeral. As this study shows, however, the formation of favourable environments for experimentation through recurring dynamics of protection, connectivity and conflict can sustain a multiplicity of experiments and lead to more perennial outcomes that enable the development of multiple UTC factors. Moreover, with the appropriate support, traditional projects and initiatives can have effects that are analogous to experiments, generating multiple forms of learning.

To examine that potential, we expanded on the seedbeds-harbours-battlegrounds approach (Torrens et al., 2019) to reveal the processes responsible for generating and retaining UTC, and tentatively identify how stakeholders can sustain or enhance those processes. That approach revealed multiple opportunities for learning (by doing, from elsewhere, and by taking into account) that underpin and enhance various components of UTC. In Medellín's case, experimentation was crucial for developing an empowered community of practice of architects and planners (C3), developing system awareness and vision about the potential of urbanism to redress the multiple crises faced by the city (C4 and C5), and rekindling governance arrangements (C1).

At present, the UTC framework provides a rich language with which to unpick the capacities required for transformations. Further bridging that with urban experimentation can elucidate the intangible outcomes that are presently neglected. It can also help redress the literature's overemphasis on singular experiments and laboratories. By embracing that plurality of ways in which urban experimentation may develop, researchers can aid urban stakeholders to make sense of complex, uncertain and messy transformation processes and consider different avenues for moving forward through reflexive practice rather than prescriptions. Efforts in this direction should explore more systematically the

different avenues for developing UTC, be mindful of the multiplicity in the forms of experimentation and learning involved and their political implications.

Medellín's unfolding transformation is a vibrant and hope-inspiring process. As the case study suggests, there is a risk of drift in the aims of urban experimentation, which deserve continued attention and critical engagement. As in many other cities, presenting the city as a laboratory and competing for international attention risks detracting from pressing challenges. At present, there is little effort to monitor, evaluate and formalise learning from these environments and reflect on their implicit directionality. That is a missed opportunity for capacity development. Future research could establish evaluative and reflexive engagements that allow stakeholder to collectively monitor and instigate organic experimentation in their cities, tapping into the various avenues for learning and developing capacities, and to reflect critically on their direction of travel.

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6 SYNTHESIS AND CONCLUSION

In this chapter, I revisit the research journey I undertook and summarise the findings of this thesis, addressing the research questions raised in the introduction and reviewing contributions of the different research papers it comprises. I also critically reflect on the thesis' methodology, before highlighting the implications to the governance of urban experimentation and for practitioners in this domain.

6.1 Reflections on the research journey

> Learning takes place in the interplay between search and discovery. Where search is concerned, the current framework is used to guide the research process in a cumulative manner. Discoveries, which cannot be planned in advance, force us to reconsider the prevailing framework. The combined efforts (…) are seldom explicitly presented to the reader. We are convinced that learning in the research society as a whole would be improved if more of the processes of how we have learned were revealed (…)
>
> (Dubois and Gadde, 2002, p. 560)

The framing of this thesis and its research strategy are the result of a long and winding journey, which resulted from a research strategy committed to exploration and problematisation. I recount this journey here to reflect on my commitment to this topic and to articulate its salience. I also hope to elucidate the conceptual development achieved through the abductive process.

Drawing from critical realism and an abductive inference, I sought to develop 'non-linear' case-studies inspired by the method of 'systematic combining' proposed by Dubois and Gadde (2002, 2014). Following their example, I present here the key redirections and attempts at matching carried out in the thesis. On hindsight, this journey looks relatively smooth, as I omit many other dead ends to focus on the key movements between theoretical and empirical work which led to this document. I also present the key references which influenced the redirections in this research. With regards to the cases, this section helps to revise the process through which the two cases 'evolved' during the research (Dubois and Gadde, 2002).

Table 6.1 Redirections of this thesis' research journey

Redirection ***(outputs)***	**Phenomenon of interest**	**Analytical focus**	**Theoretical influences**	**Empirical observations motivating redirection**
Departure point	Urban sustainability transitions and trend towards (re)municipalisation	The changing role of municipalities in urban sustainability transitions	MLP, emerging discussions about the role of cities in sustainability transitions	Remunicipalisation as recent phenomena in city with much longer history of grassroots engagement
1st redirection	Localised proliferation of sustainability initiatives	Relationships between municipalities and grassroots groups	Grassroots innovation literature, social movement theories (strategic action fields)	Closer ties between grassroots and council central to forming that environment; Activities analogous to experimental processes
2nd redirection *(1st paper)*	Sustained urban experimentation	Unpacking the formation of a favourable environment for experimentation with sustainability	Strategic niche management, geography of transitions, urban experimentation and urban laboratories	Organic forms of experimentation not accounted for by focusing on laboratories. Dynamics distinct from those associated with niches
3rd redirection *(2nd paper)*	Sustained urban experimentation	Capturing different understandings of the role of urban experimentation and dynamics influencing it	SNM and wider literature on urban experimentation	Potential of sustained urban experimentation in generating transformative capacity
4th redirection *(3rd paper)*	Sustained urban experimentation	Examining contribution of urban experimentation to UTC	Urban transformative capacity, contextual perspective on sustained urban experimentation	Need to explore other avenues for UTC development

6.1.1 Initial interest in urban transitions and (re)municipalisation

I began the PhD in September 2014, with a general interest in sustainability transitions. Before joining SPRU and the transitions community, I was most familiar with the global environmental change field and was gradually familiarising myself with the transition studies. Early on, after delving in the different approaches of transitions study (Grin et al., 2010; Markard et al., 2012), in concertation with my supervisors, I decided to revisit the preliminary proposal to better align it with a growing interest urban sustainability transition. Despite my supervisors' extensive engagement with transitions literature, I had considerable freedom to explore and propose different approaches.

My interest was initially captured by *urban sustainability transitions and the trend towards (re)municipalisation* (Becker et al., 2015; Blanchet, 2015; Hall et al., 2013; Moss et al., 2014), whereby municipalities around the world had been establishing municipal-utility companies in domains such as energy, transport and water provision. I was interested in the role such companies were playing in sustainability transitions, and the prospect of an emerging 'civic' energy sector (Barton et al., 2015; Hall et al., 2015, 2016; Hannon and Bolton, 2015). Re-municipalisation was advancing quickly in Germany and the UK, among others, with communities, municipalities and grassroots activists trying to stake a claim over ongoing energy transitions, reframing them to emphasise local development, ownership, and state restructuring, often in direct opposition to prevalent understandings of the what should be the role of the state.

That trend chimed with questions about the role of the cities and regions in shaping alternative visions for sustainability transitions (Bulkeley et al., 2011; Hodson and Marvin, 2009, 2010; Rohracher and Späth, 2013; Späth and Rohracher, 2010). It resonated with a wider discursive shift that repositioned the state as a key driver of innovation and green entrepreneurialism (Mazzucato, 2015a, 2015b), albeit with a localist twist. However, it also signalled the contribution of grassroots innovation movements to contesting and proposing alternative pathways for development (Becker and Kunze, 2014; Blanchet, 2015; Seyfang and Haxeltine, 2012;

Smith et al., 2016). That contrast indicated potential tensions for those concerned with bringing about 'transformations from below' (Smith and Ely, 2015). It seemed an noteworthy arena in with entrepreneurial municipal state and grassroots innovation movements encountered one another, creating a distinctive political setting.

In April 2015, to scout possible case studies, I attended the annual conference of Energy Cities, a trans-municipal network advocating for re-municipalisation. Bristol stood out as a potential case study, as it was about to launch its municipally-owned energy utility and was perceived as a leader in that network. I had also been in contact with Jake Barnes, a PhD candidate in SPRU researching the role of community energy groups and intermediaries in embedding innovations (Barnes, 2015; Bird and Barnes, 2014) and was aware of the city's burgeoning community energy scene (Bird et al., 2013), and proactive leadership in international municipal networks, and overall sustainability profile (e.g. European Green Capital Award). For those reasons, I started a pilot case in the city.

Closer engagement in Bristol brought up another issue, as it became apparent that it was but a recent expression of a much more. Previous studies revealed a much longer history of grassroots movements (Amin et al., 2002; Brownlee, 2011; Diani, 2015; O'Doherty et al., 1999; Purdue et al., 1997, 2004), of which the recent development of community energy groups was a recent expression, with networks and shared identities. The latter were reminiscent of accounts about Totnes, a village notorious for pioneering the 'transitions town' movement (Longhurst, 2013, 2015), and of the combative place-based social movements that driving (re)municipalisation in Germany cities (Beveridge and Naumann, 2015; Blanchet, 2015; Moss et al., 2014). The importance of municipalisation was contested among the cities' many grassroots groups, which saw the process with a degree of suspicion.

6.1.2 Localised proliferation of sustainability initiatives

Those observations led me to develop an interest to the phenomenon of *localised proliferations of sustainability initiatives* (1st redirection) with a concern for understanding how such proliferations emerged in particular cities and places and what motivated their normative agendas.

Different research communities were engaged in these questions. There were apparent connections to the emergence of community energy in the UK (Walker, 2008; Walker et al., 2007b; Walker and Devine-Wright, 2008) and to debates in the grassroots innovations literature (Seyfang et al., 2013b, 2013a; Seyfang and Haxeltine, 2012; Seyfang and Smith, 2007; Smith, 2006a, 2006b). I also noted similarities with debates in neo-institutional theory and social movement theories, particularly in the strategic action field approach, which had been used to examine similar phenomena in Germany (e.g. Blanchet, 2015). The latter approach emphasised initiatives that were more overtly political, confrontational, not reliant on innovation per se, but which were nevertheless contributing to systemic change of the kind that interest transition scholars.

What I was observing in Bristol, however, fit uncomfortably with the debates that focused solely on community energy groups. There were tensions between grassroots groups, reminiscent of the relationship between grassroots groups and mainstream institutions (Fressoli et al., 2014; Smith et al., 2014), but there were also close ties between the city administration and community groups, with considerable 'permeation of capacities' between the two (Emelianoff and Mor, 2013), alongside with competing interests and framings of what was at stake. It also was not easy to distinguish niche actors and regime actors, and competition between different community groups was equally relevant.

Gradually, I became concerned with what made it possible for places like Bristol seemed to develop (socio-cultural) environments able to sustain, over a long period, such vibrant and diverse activities. I realised that many cases in the literature referred to places with similar dispositions - e.g. Berlin (Blanchet, 2015;

Ewert, 2016; Novy and Colomb, 2013), Brighton (Hielscher et al., 2012; Schwanen, 2015), Freiburg (Platzer, 2015; Rohracher and Späth, 2013), Graz (Rohracher and Späth, 2013; Schreuer et al., 2010b), Totnes (Longhurst, 2013, 2015), and specific neighbourhoods of London (Håkansson, 2018). It was striking that such places could maintain a reputation for their countercultural and environmental movements and amass a large number of initiatives in multiple domains of sustainability, while also transforming the political atmosphere of their cities. It was also intriguing that a large number of supposedly ephemeral initiatives happening in those places became long-running organisations or even movements. In Bristol, even when focusing on activities contributing to a localised sustainable energy transition, one would encounter a many grassroots groups, city officials, businesses experimenting with a multiplicity of technologies and social innovations, old and new, that they hoped could catalyse change (Amin et al., 2002; Brownlee, 2011). The city hosted an enormous variety of intersecting initiatives, community energy initiatives forging novel partnerships with the local government, to new forms of peer-to-peer energy advice, to large-scale infrastructural projects that would be new-to-world.

At that time, the geography of transitions debates was emerging (section 1.2.3, p.29) with a growing number of cases taking the city as the unit of analysis (Bulkeley et al., 2011; Frantzeskaki et al., 2014; Hodson and Marvin, 2009, 2010, 2012; Longhurst, 2015; e.g. Rohracher and Späth, 2013). I was very familiar with the SNM literature, which for long argued that niches were central to the emergence of radical novelty and that they could potentially explain this form of agglomeration. However, the geographical turn revealed many limitations to 'adopting' SNM or the MLP to study subnational processes but offered little resolution and no consensus on how to frame or approach the research of these topics.

Compounding this issue, I was also grappling with labelling the objects of my interest (activities, initiatives, experiments, projects) and the environments in which they emerged (spaces, places, milieus, niches, arenas, and so forth). For each label, there were multiple definitions and a lack of comprehensive studies comparing and contrasting them. SNM had for long used the notion of

experimentation, and the literature in that domain was the one with more nuance (Sengers et al., 2016). At the same time, geographers and governance scholars had been chronicling a trend towards climate change (governance) experimentation (Bulkeley and Castán Broto, 2013; Castán Broto et al., 2013; Castán Broto and Bulkeley, 2013; Evans and Karvonen, 2011, 2014; Hoffmann, 2011b) with some parallels to what I was observing.

6.1.3 Sustained urban experimentation

Around 2016, research and practice on climate and urban experimentation was accelerating, with a large number of new studies (Ansell and Bartenberger, 2016; Evans, 2016; Evans et al., 2016; McFadgen and Huitema, 2016; McLean et al., 2016), and a growing hype around the concept in media outlets. I was exposed to such diversity in April 2016, when I had a chance to participate in one of the workshops that contributed to the development of 'Innovation in Climate Governance: Beyond Experiments' book (Turnheim et al., 2018b). The studies in that workshop showed that experiments were more ubiquitous and diverse than I had previously thought, with more complex outcomes that went beyond what had previously been theorised in the SNM literature I was familiar with (Heiskanen and Matschoss, 2018; Hölscher et al., 2018).

However, much of the discussion was centred either on experiments themselves (as initiatives, experiments, projects, partnerships) or in designated spaces for experimentation (i.e. laboratories of different kinds), while neglecting other more organic forms of experimentation which my empirical engagements demanded. However, the question I had been posing - of how particular places could sustain transitions' related activities for long period - was only tangentially discussed.

Noticing that gap, I redirected the research once more (2nd redirection), to focus on the phenomenon of *sustained urban experimentation*, by which I mean the concentrated and prolonged existence of multiple instances on varied forms of urban experimental processes in a particular place. Reading more widely, I

encountered other instances of such agglomerations and proliferations, albeit with other framings.

The work of Amin et al. (2002) on 'placing the social economy' suggested it was possible to focus on the environment of the city itself, and its dynamics, as a way of understanding how it could enable and sustain high levels of civil society engagements and the development of a robust environmental movement. Furthermore, Cohendet et al. (2010) and van den Bosch (2010) highlighted that these dynamic processes that could be self-reinforcing, while Longhurst (2015) highlighted the cultural and symbolic aspects which could explain the persistence of such environments and their strong association with a particular place. Meanwhile, Schwanen (2015) and Hodson et al. (2017) drew attention to the multiplicity of (loosely-bound) experimental processes co-located in particular places.

Thus, in the first paper, which I co-authored with my supervisors, we focused on 'unpacking' the formation of a favourable environment for experimentation in Bristol. Mindful of the geographical critiques to SNM and MLP, we sought to articulate a place-based approach and to be explicit about how the governance arrangements co-evolved with experimentation.

6.1.4 Contextual dynamics and environments for experimentation

While writing that paper, I was also struck by how quickly the literature shifted its focus towards urban laboratories (Bulkeley et al., 2016; Evans and Karvonen, 2011, 2014; Karvonen and van Heur, 2014; Nevens et al., 2013; Voytenko et al., 2016). That perspective, emphasising designated spaces for experimentation and learning, stood in contrast with the more unruly, organic and diffuse forms of experimentation that were prevalent in Bristol, where the formalisation of experiments was but a recent development entangled with efforts to boost the international reputation of the city. At the same time, SNM did not seem to fully capture the long history of contestation and collaboration that seemed generative for experiments. For a moment, we considered analysing the case with two

theoretical lenses, SNM and SAF, to highlight the contrast between innovation-centred and social movement-centred accounts of urban transitions, influenced by the analysis by Smith et al. (2016) of different perspectives on grassroots innovations. They were both internally consistent arguments that highlighted certain aspects of a complex phenomenon, but which were nevertheless partial. That discussion quickly outgrew the 1st paper.

In parallel with those developments, a more contextual or place-based perspective was surfacing in the literature, that highlighted the history of particular places and the emergence of place-specific styles of experimentation (Longhurst, 2015; Raven et al., 2017b; van den Heiligenberg et al., 2017). Hence, I turned the analytical focus (3rd redirection) to examine how the literature conceived the urban context, its relationship to experiments and the different forms of learning, politics and intermediation privileged by different perspectives. During a visit to Utrecht University, hosted by Rob Raven, he suggested 'problematisation' as a way of examining the assumptions in the literature. I thus lead the effort to write the second paper, with my supervisors and Rob as co-authors.

That paper demonstrated that a variety of contextual dynamics had already been reported in the literature, which were worth candidates for analysis. It built on the idea of articulating distinct theoretical lenses, which was further expanded through the literature review.

6.1.5 Experimentation and transformative capacities

Concomitantly, I had the chance to visit Medellín, which at the time was becoming a reference point for urban transformations, due to 'the miracle of Medellín' (Bahl, 2012; Davey, 2016; Fukuyama and Colby, 2011; Maclean, 2014, 2015a; Moss, 2015). Reading about this process, I noted that despite the 'miracle' label, the city had a much longer history of innovative approaches to mobility and urban development (Bahl, 2012; Simmons et al., 2018), with some evidence of urban experimentation led by the municipal administration. The city, then, presented a great opportunity

to continue exploring the formation of a favourable environment for experimentation in a distinct context (see section 2.3.1, p.75).

Meanwhile, scholars studying systemic change in cities began exploring the notion of transformative capacities (Hölscher et al., 2018; Wolfram, 2016). The framework proposed by Wolfram (2016), in particular, provided a comprehensive language to describe the multitude of processes that contributed to developing the ability of stakeholders to address systemic change in cities. At the same time, the framework itself had little to say about how capacities developed over time. Nevertheless, the notion of capacities could shine new light on the indirect contribution of diffuse forms of experimentation to systemic change (Heiskanen and Matschoss, 2018). That emerged concomitantly with valid concerns over moving 'beyond experiments' and reconnecting the discussion to the systemic impacts (Turnheim et al., 2018a).

Therefore, I redirected the study once more (4th redirection) to zoom into the *link between the formation of favourable environments for experimentation and the development of urban transformative capacity*, which remained underexplored. A case study in the Medellín, I thought, would offer me a window into a quite distinct environment which had nevertheless also given rise to sustained urban experimentation and capacity development, which led to the third paper. The activities described in that paper were not framed as clearly around environmental sustainability, concerning social sustainability, in terms of social inclusion and the reduction of violence. That speaks to the degree to which local priorities shape what is considered sustainable.

Writing this chapter and the introduction pulled together and helped me to reflect these distinct steps, revealing the journey which had not been planned. The two first redirections revealed the salience of sustained urban experimentation; the others allowed me to 'zoom in' different aspects of that phenomena. Rather than selecting cases, in the traditional sense, I 'found' cases as the research developed and new issues became more salient. Taking the mismatches between theory and empirical observation as a generative space was a fruitful research strategy to

explore the formation of favourable environments for experimentation. The theoretical improvements I proposed resulted from 'frictioning' those cases with the emerging frameworks, questioning the assumptions of the theories through problematisation, and gradually updating the concepts I used. Adopting a relatively open conceptualisation of urban experimentation was essential to allow for that exploration.

6.1.6 Reflections on the methodological approach

This research took on an exploratory route. It required casting a wide net when dealing with the literature and working with an object of study that was at first fuzzy. To the extent possible, I sought to make the research twists and turns of that journey legible in these preceding sections.

In that, this research was not aimed at determining causality as it was with establishing plausibility and expanding the frame of what is presently considered by the theories. It was also not concerned with finding a universally applicable model that explains the formation of favourable environments for experimentation everywhere, but instead contribute towards developing an approach, a way of seeing experimentation, that provokes other questions and shines a light to different forms of engagement. In that regard, the methodology was successful.

A more conventional research design, with a clearly defined hypothesis to be tested, would not have worked for the purposes of this thesis. In large part, the theory was too fragmented to begin with. More than finding gaps in the literature to be filled, the idea of problematisation and the friction with the cases helped me articulate what were the issues with the present approach that needed to be changed.

The dynamic, open-ended, multi-actor, multi-interest nature of transition processes, which deal with open systems, over long periods of time, means that causality is always elusive. In line with the brief discussion on critical realism earlier (section 2.1, p.56), I therefore argue that case studies present provisional explanations which enrich our understanding of those processes. Even

provisionally, these serve to reflect other complex unfolding processes, for example, on the design and conduct of specific experiments and laboratories and on the development of urban transformative capacity.

Because of the abductive and exploratory approach adopted, I relied on two case studies that were not framed by a strict comparative framework, but as an implicit form of 'relational comparison' (Ward, 2010)(see section 2.2, p.61). Writing the papers simultaneously meant that the case studies coloured the second paper, and vice versa. The contrast between what I observed in Bristol and in Medellín highlighted the relevance of the dynamics raised in the second paper, but also showed how place-specific their expressions were. I am by no means suggesting that protection, connectivity and conflict explain the formation of favourable environments for experimentation everywhere. Instead, I am arguing that this set of dynamics is plausible and that scholars would be better served approaching the specific contexts with them in mind than assuming an even narrower set of explanations.

Studies in this domain have begun addressing structured comparison, with multiple cities, to examine 'place-specific factors' and 'success factors' and develop typologies (Feola and Nunes, 2014; Sekulova et al., 2017; van den Heiligenberg et al., 2017). Albeit also proposing a 'contextual' perspective of experimentation, such methodologies require framing questions differently, and thus lead to approaching issues from different perspectives. Thinking in terms of self-reinforcing dynamics, as I did here, does not suit well methodologies that search for factors. Nevertheless, there is value in maintaining the methodological diversity of the field whilst building a dialogue between these approaches.

6.2 Meta-reflections on the papers

Here, I aim to address the research question raised in the introduction (section 1.4, p.49).

6.2.1 RQ1 - How can the long-term evolution of favourable environments for urban experimentation be studied?

The first aspect a transition scholar should consider when studying the environments in which experimentation flourishes regards *the focal socio-technical system or configuration* they are foregrounding[8]. As shown in Table 6.2 (p.228), it is possible to discern at least five distinct modes of analysis.

[8] This does not include the Technological Innovation System, in which the unit of analysis is the emerging technological system itself

Table 6.2 Modes of inquiry prevalent in the transitions literature

Mode of inquiry	***Focal system(s) or configuration(s)***	**Understanding of environments for experimentation**	**Probable stakeholders and audience**	**Examples**
TRADITIONAL APPROACH (MLP)	*Nationally or internationally structured socio-technical systems*	Experimentation 'across places', where learning from multiple places is aggregated in a 'cosmopolitan' or 'de-localised' level	National level policymakers, experts, transnational environmental groups and grassroots innovation movements	Most case studies in transitions focused on technological developments (e.g. solar PV, Wind turbines) (Ornetzeder and Rohracher, 2013; Raven et al., 2016a; Verhees et al., 2013)
TRACING TRAJECTORIES	*Emergence of particular socio-technical configuration through trans-local processes*	Experimentation occurring as a particular design or idea travel 'through places'	Communities involved, technology proponents, intermediaries, experts	Development of the Bus-rapid-transit system (Carvalho et al., 2012; Sengers and Raven, 2015); Wave energy (Fontes et al., 2016); Spread of community energy innovations (Carvalho and Lazzerini, 2018)
PLACE-BASED APPROACHES	*Emergence of a favourable environment for experimentation or localised concentrations of experiments*	Multiple experimental processes happening 'in a place', intertwined with the development of the place (city or region) itself	Grassroots groups, local or regional governments, local businesses and organisations citizens	The papers in this thesis. Also, mobility experiments (Hodson et al., 2017; Schwanen, 2015); Alternative milieu (Longhurst, 2015) Habitats (van den Heiligenberg et al., 2017); Smart city experimentation (Raven et al., 2017b); Relational placemaking (Håkansson, 2018; Murphy, 2015).
LAB-BASED APPROACHES	*Laboratory and other designated spaces for experimentation*	Multiple experiments happening 'in a lab', intertwined with the development of the place (city or region) itself	Lab stakeholders, including grassroots groups, local or regional governments, local businesses and organisations, citizens. Researches as co-creators	Urban transition labs and transition arenas (Frantzeskaki et al., 2014; Frantzeskaki and Kabisch, 2015; Nevens et al., 2013; Roorda et al., 2014), Urban living labs (Bulkeley et al., 2016; Evans and Karvonen, 2011; Marvin et al., 2018; Voytenko et al., 2016), Real-world laboratories (Schäpke et al., 2018)
TRACING EXPERIMENTS	*Individual experiments*	Experiment happening against a 'place in the background'	Participants of the experiments, users	Evaluation of specific experiments (Brown et al., 2003; Brown and Vergragt, 2008; Luederitz et al., 2016)

As the geography of transitions and urban transitions literatures revealed, this step is often left implicit and unjustified as if the socio-technical systems in question had natural borders and boundaries, and as if the scales were fixed and uncontested. However, even when the city is taken as a unit of analysis, the focal point matters. The analyst is always foregrounding certain elements and backgrounding others. This volume centred on the place-based perspective, which remained under conceptualised despite many recent studies.

When studying the emergence of a favourable environment for experimentation, I found three analytical tasks to be necessary (Table 6.3).

Table 6.3 Analytical tasks undertaken, and analytical strategy developed

Analytical task	**Analytical strategy**
Unpacking the history of the environments for experimentation	Place-based approach (1st paper)
Examine the contextual dynamics driving this development	Seedbeds, harbours and battlegrounds lenses (2nd paper)
Consider how these environments can be mobilised to support urban transformations	Extension of the three lenses to consider the development of UTC (3rd paper)

These different modes of inquiry are valid and useful ways of uncovering different aspects of systemic change. They do not form a hierarchy of importance and can, in fact, inform one another. Their salience is also dependent on who are the stakeholders or audience of the research. Moving towards recognising and developing these different modes more explicitly should facilitate dialogue and sharing of lessons, thus enhancing theoretical consolidation.

The first analytical task consists of *'unpacking' the history of the environments for experimentation*. Here, the place-based approach presented in the 1st paper can be useful. As I argued then, the traditional approach of SNM was limited when considering urban experimentation and the prospects of urban transformations due to its implicit geographical assumptions.

Transition scholars need to confront the multiplicity of experimental processes (in a variety of domains) that are often co-located in particular cities, and which may compete, complement and co-exist, potentially reconfiguring the city's constituent

systems (Hodson et al., 2017). These are after all 'multi-interest contexts', in which the rationales for urban experimentation are contested and negotiated (Heiskanen et al., 2015) and change over time in part as a result of experiments.

To address those issues, I argued for the adoption of 'place-based perspective'. This 'way of seeing' urban experimentation came about by bridging between the local-global model (Geels and Raven, 2006; Smith and Raven, 2012) and the contextual reconfiguration approach (Hodson et al., 2017).

Crucially, the analysis seeks to characterise the evolution of a context for experimentation from the point of view of a place (in my cases, cities), and thus engage with the sites, situations and senses-of-place which shape how experimentation is carried out locally. This perspective highlights the possibility of forming a place-based niche through a process of contextual reconfiguration and demands further attention to the co-evolution between patterns of experimentation, the modes of governing and the understandings of sustainability. The notion of settlements shed light on the periods with relatively stable constellations of actors and framings of what is at stake. Understanding how different settlements emerge, and what forms of experimentation they privilege should provide insight into why particular styles of experimentation prevail in certain places and periods.

For that perspective to be useful, it is important not to impose a too-strict assumption of what constitutes an experiment and what kind of space support it. In effect, *that is the central empirical effort: uncovering the forms of experimentation and the mechanisms which sustain it.* Whether socio-technical experimentation or governance experimentation is more critical is context-dependent and not knowable a priori. Whether the socio-technical regime is the main barrier to the emergence of experiments is an empirical rather than a theoretical question. In different places, the thought goes, different constraining or enabling dynamics may be more relevant, always mediated by the agency of those involved. In effect, the overbearing presence of certain elements of the energy regime – as with the nuclear waste trains crossing Bristol - may be a

generative force in the search for alternatives. However, that was only the case because of the emergence of grassroots groups that made that issue visible and rallied around it.

Deepening that insight, the second paper argued that what stands for a 'favourable environment for experimentation' should not be assumed, a priori, to behave as niche, as conceptualised by the SNM literature, nor to a designated space for experimentation, such as a laboratory or transition arena. By problematising the literature and proposing a pluralistic synthesis, my co-authors and I articulated the seedbeds, harbours and battlegrounds lenses - each highlight distinct understandings of what constitutes the urban context, and of the contextual dynamics which may give rise to favourable environments for experimentation. We argued that analysts should be open to explore a multiplicity of processes which may contribute to shaping (both enabling and constraining) experimentation. Adopting such a pluralistic stance demands reflection on what processes are salient in their particular contexts, drawing from a broader set of theoretical positions, rather than committing up front to a particular model or approach.

The third paper, in turn, explored how favourable environments for experimentation can be mobilised to support urban transformations. That question too cannot be responded in general, for all cities, everywhere. Instead, I showed that these environments might contribute to the development of urban transformative capacity in multiple ways. Experimentation can thus be seen as both the outcome and source of urban transformative capacity. Different forms of learning associated with experimentation are relevant to both the generation and the retention of urban transformative capacities. Hence, transition scholars may seek to assess which components of urban transformative capacity have been serviced through experimentation and whether further support to experimentation would address underdeveloped components.

Upon reflection on the definitions of experimentation, it became clear that imposing a strict definition of what counts as an experiment would in effect

exclude many of the processes that were effective in the contexts studied. Thus, the pluralistic stance should be complemented with a looser approach to 'urban experimental processes' which treats 'what is an experiment?' as a contextual and empirical question rather than a universal construct that is either verified or not. Awareness of the different purposes, logics and loci of experimentation is thus useful.

As argued in the third paper, experiments should not be distinguished exclusively by their characteristics and goals (e.g. practice-based, learning-oriented, challenge-led), but also in their relationship with the context. Here, it is relevant to ask what mechanisms there are for supporting learning, and thus generating and retaining urban transformative capacities.

In hindsight, I have collated a set of questions and probes which an analyst may use to exploring the formation of favourable environments for experimentation in a particular place (neighbourhood, city or region)

Table 6.4 Probes for interrogating the formation of favourable environments for experimentation

Areas for enquiry	**Probes to support the analysis and reflection**	**Summary of Case in Bristol**	**Summary of Case in Medellín**	**Insights from juxtaposing the cases which influenced abduction**
Is there, historically or presently, in this place, a sustained level of innovative or experimental initiatives or activities?	i) What use(s), logic(s) and loci of experimentation are prevalent? a) Are/were they framed explicitly as innovative, experimental or radical? ii) In what domains of sustainability? iii) Are there persistent… a) patterns experimentation? b) framings of sustainability? c) actor-constellations involved in experimentation? iv) What barriers, struggles or tensions have they encountered in trying to advance their experiments?	Sustained experimentation regarding multiple domains of sustainability (energy, mobility, waste, food), with prevalence of organic experimentation driven by grassroots groups, with more recent attempts to formalise and scale up experiments in Energy. Recurring references to experimentation, pioneering and innovation. Different patterns of experimentation overtime, multiple framings of sustainability overtime, with corresponding changes to actor-constellations (Table 3.2). Lack of resources, fragmentation and duplication of efforts have been recurring challenges, despite efforts to orchestrate.	Since 1980s, sustained experimentation regarding mobility and integrated urban development, not explicitly framed as experiments until recently. Implicit forms of experimentation, where interventions produced similar outcomes to experiments due to the characteristics of the context (community of practice, retention of professionals). Social urbanism as central framing and guiding principle behind most significant interventions. Lack of legitimacy of the state, history of violence, and relative isolation of communities involved.	*Sustained forms of organic* experimentation was under conceptualised and neglected Multiple interconnected domains of sustainability, and intersection between different initiatives, highlighting *multiplicity* Distinct patterns of experimentation and governance overtime, which inspired analysis of distinct *settlements* Distinct political tensions and meanings and history associated with experimentation, highlighting need for *place-specificity* and emergence of relevant sectors
Is there, historically in this place, evidence of an established favourable	v) What are the supposed origins of such environments? a) Are the actors presently involved aware/proud of that history? b) Are there (policy) narratives	Long standing and notorious 'alternative milieu'. Nowadays, part of official narrative about the city, and central to recent efforts to promote investment. 'Energy scene' has developed	Long-standing community of practice around architectures and planners, and close ties between municipality and university as key in generating and retaining capacities.	Place-specific trajectories, with importance of mechanism for generating and retaining capacities Distinct dynamics active at

environment for experimentation?	which tie past and present activities? vi) Were there distinctive periods (settlements) in its evolution? vii) What contextual dynamics played a role in the formation of this environment? viii) How has this environment contributed to or hindered the development of transformative capacities?	more recently, with concentrates grassroots and municipally led experimentation with community and municipal energy provision (civic energy experimentation). Initially, signs of battleground dynamic, but of late combination of seedbed and harbour dynamics (implicit in Table 3.2) Considerable 'percolation' between grassroots and municipal efforts.	On the mobility domain, primarily led via Metro company, and other municipal entities. Wider participation in the integrated urban project aspect. Initially disruptive, followed by battleground-like and lately, seedbed and harbour-like dynamics (Table 5.2)	different periods, inspiring the *three lenses approach* Efforts to frame city as laboratory very recent in much longer history of organic developments Importance of the favourable environment for the generating and retaining urban transformative capacities.
Is there, presently and in this place, evidence of an emerging favourable environment for experimentation?	ix) What contextual dynamics play a role in the formation of this environment? x) Is there a narrative or policy that praises or supports experimentalism (e.g. city as a laboratory)?	Harbour-like dynamics increasingly prevalent, with efforts to promote city internationally and pursuit of prizes. Recent attempts to formalise and institutionalise the environment, with large city wide partnerships with relative success. Multiple recent policies attempting to leverage grassroots initiatives, creating tensions with established movement.	Harbour-like dynamics increasingly prevalent, with efforts to promote city internationally and pursuit of prizes. City increasingly promoted as a 'laboratory' and exemplar, associated with effort to promote city as hub of innovation. Tensions with new narratives of the city as a model, raising criticism from many of the influential actors in the past. Increasing public rejection of claims about innovation.	Interaction between different dynamics is important. Possibility of using lenses for diagnostic. Need for critical engagement with presenting city as laboratory.

Who takes part of this environments?	xi) Which actors feel part of such an environment? xii) Who is thought to belong or participate? a) What are the opportunities for participating (e.g. festivals, meetings, co-location)? b) What benefits can be derived from participating? c) Who is excluded? xiii) What supports (formal and informal) learning from those activities? a) Are there researchers involved? b) Are co-creation or co-design used? xiv) How are the activities in this environment coordinated/orchestrated/governed? a) What forms of partnership or joint work are common? b) How does this environment relate to the governance of the city? xv) What roles do intermediaries play?	Actors voiced concerns about inclusivity of the alternative milieu (green middle class) Considerable support for learning from academics and local intermediaries (e.g. CSE). Emphasis and local capacity for co-creation is high. Multiple attempts at orchestrating overtime, with various informal spaces and co-locations of activities. Alternative milieu and energy scene hold considerable influence in shaping policies, but council is seen as increasingly 'muscular' Crucial intermediation with high degrees of expertise and engagement, but little dedicated funds (e.g. CSE and BEN).	Actors voiced concerns about inclusivity of most recent policies (distancing from Social urbanism), and outward focus. Community of practice around architecture and planning is very influential but relatively small. Historically, there has been emphasis on public participation, and experimentation with models to promote it. Close ties between municipality, academics and private sector with emerging intermediaries (e.g. Ruta-N). Well-funded institutional structures that formalise collaborations. Considerable planning capacity and city and regional level creating overall vision.	Need for more intentional and competent approach to address favourable environments for experimentation, in which academics can play an important facilitative and convening role.

6.2.2 Beyond experiments? Towards what?

Recently, there have been many calls for research to go 'beyond experiments' (e.g. Turnheim et al., 2018b). Notwithstanding the definitional problems that we discussed in previous chapters, these calls tend to imply the need for rescaling ambitions associated with what can be achieved with experiments and repositioning the analytical gaze. In light of this thesis contribution, it is important to unpack the possibilities offered.

At first, this could be interpreted as a call for rethinking the importance of experiments in systemic change, deemphasising its potential, and focusing on other activities or processes deemed to be more transformative. Associated with this kind of call is the thought that experiments happen on the early stages of a multi-phase process, and that once a clear solution emerges, the question becomes one of scaling up experiments to achieve substantial impacts. Prominent transition scholars, such as Prof Frank Geels, have repeatedly expressed the view that what is needed is acceleration, rather than more experimentation. In that perspective, practitioners and transition scholars are expected to find ways to grow, to mature, to become normalised, mainstreamed, and so forth. The language used to describe these phenomena continues to expand considerably, to the point of exhaustion (Naber et al., 2017; Seyfang and Longhurst, 2013; van den Bosch and Rotmans, 2008). That view makes sense when addressing *nationally or internationally structured socio-technical systems*, or the *emergence of particular socio-technical configuration through trans-local processes* (Table 6.2, p.228). However, it makes very little sense when considering a place-based perspective, which would place more emphasis on the extent to which experimentation is helping to address challenges structured and made sense of at the level of the city.

Another way of looking 'beyond experiments' is to reconsider what is meant by scaling and acceleration, to consider with more nuance the forms of embedding which connect experiments and systemic changes. That avenue, explored in detail by (Turnheim et al., 2018a), reveals a much more complicated picture of the different ways in which experiments may, in fact, contribute to change, of which

scaling is one of four key processes. More nuanced evaluation, preferably with participatory components, thus shows promise to trace that which remains of experiments once they are passed.

A critical insight of this thesis is that if there are sustained levels of experimentation, and evidence of an established or emerging favourable environment for experimentation, the efforts to govern urban sustainability transitions may work towards mobilising these environments. This stands in contrast with the scaling the outcomes of specific experiments, or the emphasis on establishing new experiments or laboratories. This mobilisation can generate a politics of engagement as seen during the second settlement in Medellín. Or it can take the form of leverage, as in the fourth settlement in Bristol, in which case it generates similar tensions to those generated by 'insertion' (Fressoli et al., 2014; Smith et al., 2015). Either way, urban experimentation is integral to the politics of place.

The results of this thesis caution against imagining transitions as the outcomes of a small set of experiments. That has long been the view the sustainability transitions literature, with the evolutionary underpinning of that theory emphasising the importance of variation and selection, rather than a linear connection between experiments and systemic outcomes. However, with the recent emphasis on laboratories, there is a risk of returning to the idea that a particular laboratory will open up entire new pathways to transitions. That is alluring for practitioners, in that it provides a narrative that emphasises the possibility of fomenting creativity, controlling experiments, and bringing together 'the right people' which can increase the chances of success.

Throughout the thesis, I sought to advance a third way to move 'beyond experiments'. In each of the articles, I attended to the context in which they happen to understand what kinds of processes or environments could sustain experimentation. In the sustainability transitions literature, that impetus has always been present, but has become too strongly associated with the notion of protection, and more recently, with the notion of laboratories. My research shows

that there is a value in paying attention to more diffuse, organic, and somewhat unruly forms of experimentation, that is actually taking place, outside laboratories, and not necessarily under protective conditions. Taking a longer-term perspective and focusing on particular places showed a much more tortuous relationship between experimentation and systemic change, in which a multiplicity of experimental processes co-evolved with governance arrangements and the framing of sustainability and contributed to developing capacities for change.

At the very beginning of this document, I discussed the notion of the Anthropocene, and how it highlights the multiple, synchronous challenges associated with global environmental change. As I argued then, cities are likely to play important but fraught roles in those processes for many years to come. Urban experimentation is likely to become more critical as we brace for the uncertainty and ambiguity generated by those challenges.

As the two cases have shown, in a long enough timespan, the object of experimentation, the forms of learning, and the rationales underpinning it change dramatically. In sum, we should move beyond experiments but not beyond experimentation, in its multitudes of forms and its distinct politics.

6.3 Contributions and originality

This document's core contribution has been advancing a distinctive contextual perspective on urban experimentation, which opens new analytical and governance avenues. Table 6.5 (p.242) summarises the contributions of the different papers, and the global contribution of thesis.

First, it articulates a rather fragmented literature to propose concrete analytical tools which can clarify the processes implicated in the formation of favourable environments for experimentation and the contribution of these processes to the development of transformative capacity. This involved delineating these environments as an object of study, revisiting what was conceived of as experimentation, and examining the contextual dynamics which may be of relevance. In doing so, this thesis opens a new avenue to expand the scope of

studies in the tradition of strategic niche management. It has shown that this tradition has many core elements which could be adapted and made more relevant to the study of contexts in which urban experimentation thrives.

The transitions field has been had a strong reliance on process theories that provide relatively neat schemes for how a transition unfolds (e.g. the S curve, the multi-phase approach). These are powerful tools for imagining and communicating insights about the processes of transition. However, if taken to literally they can be desensitising to other unexpected factors that fall outside the theory. In the case of transitions, which thus far does not have spatiality or place-specificity explicitly discussed, that is a problem. By introducing the more neutral argument about the need for tracing the different settlements and observing what are the associated patterns of experimentation and governance arrangements associated with them, without expecting them to conform into phases, this approach could support accounts which are truthful to the messy, serendipitous ways in which experimentation evolves.

Second, the two cases draw attention to the complex history of favourable environments for experimentation, which is not linear and not undisputed. SNM has concerned primarily with sequences of experiments, which grow and are replicated, and which are thought to develop along a trajectory with increasing closure around a particular socio-technical configuration. However, if the focus is on the wider environment, there may be other avenues. Both cases show how, on the long run, experimentation is tied in with shifts in the governance arrangements.

To some extent, the case in Bristol showed the possibility of a place-based niche formation, while the case in Medellín highlighted the possibility of experiments contributing to the development of transformative capacity. Both cases highlighted that a singular preoccupation with scaling up specific socio-technical trajectories displaces other means through which systemic change in cities is achieved. This thesis suggests that on the long run, experimentation can be mobilised to shift the governance arrangement themselves, corroborating

observations made in the grassroots literature (Fressoli et al., 2014; Smith et al., 2015, 2016). For that to be possible, however, it is crucial that researchers and practitioners look beyond what is readily labelled as an experiment or laboratory.

Third, as discussed above, this thesis offers an alternative to moving 'beyond experiments' without disregarding the potential for experimentation.

Finally, the findings of this thesis could serve as an input in the development of tools for reflexive practice regarding experimentation and laboratories. There has been interest recently to the design and conduct of such processes (Bulkeley et al., 2018; Hodson et al., 2018), for which the laboratory has been the departure point. This document suggests that the laboratory and its present dispositions may reflect path-dependent styles of experimentation. Initiating new laboratories should be understood as one of many tools at the disposal of stakeholders involved in experimentation, and their design and conduct should be mindful of the activities happening beyond their borders. To some extent, laboratories should always be combined with 'observatories', to better assess that which is happening in the city, and which may be transformative or regressive. Establishing whether an experiment fails or succeeds has to take into account the context and thinking about contextual dynamics as suggested here may be a good way of doing that.

The originality of this thesis rests on its transversal approach to the literature combined with exploratory case studies. In framing this thesis as an abductive effort, and using problematisation as a method, I discovered and articulated a distinctive perspective on experimentation, summarised in Table 6.6 (p.244). Each of these have implications for analysts and practitioners involved in the governance of urban experimentation and the development of UTC.

Research in the field of transitions should be more explicit about the analytical choices and the set of dynamics assumed to be relevant. Despite the complexity and multiplicity of processes of change which fall in the scope of the field, different understandings of transitions are often presented as mutually exclusive. This study suggests more clarity about the domains of applications of their particular approaches is necessary, and that more effort is needed to juxtapose and compare

different approaches. In particular, through my engagement with the Network for Early Career Researchers in Sustainability Transitions (NEST), I noted that young researchers feel pressured to embrace and apply the established frameworks, which are implicitly understood as flexible and potentially all-encompassing, only to struggle with recognising the practical limitations of doing so. Similarly, there have been numerous efforts to provide definitive concepts about urban experimentation, rather than more pluralistic accounts that are open to the changing nature of that phenomena.

Table 6.5 Summary of the thesis publications and their contributions

	Paper 1	**Paper 2**	**Paper 3**
Title	Unpacking the Formation of Favourable Environments for Urban Experimentation: The Case of the Bristol Energy Scene	Seedbeds, Harbours and Battlegrounds: on the Origins of Favourable Environments for Urban Experimentation with Sustainability	Experimentation and the Development of Transformative Capacity in Medellín
Target Journal (ISSN)	Sustainability (2071-1050)	Environmental Innovation and Societal Transitions (2210-4224)	*Provisory:* SPRU Working Paper Series (2057-6668); *Target:* Cities (0264-2751)
Co-authors	Phil Johnstone and Johan Schot	Johan Schot, Phil Johnstone and Rob Raven	-
Status of the paper upon submission	Published (20 March 2018) as part of the special issue on 'Putting Sustainability Transitions into Spatial and Socio-Cultural Context'	Published (June 2019)	Accepted (Corrections underway)
Relevant Papers in the Target Journal	Moloney and Home (2015), Wolfram and Franzeskaki (2016), Heiskanen et al. (2017) Hodson et al. (2017), van Heilingenberg et al. (2018)	Raven et al. (2012), Hansen et al. (2015), Heiskanen et al. (2015), Longhurst (2015), Murphy et al. (2015), Truffer et al. (2015), Sengers et al. (2015), Wieczorek et al. (2015), Håkanson (2017)	SWPS: Kivimaa et al. (2015), Barnes et al. (2017), Kivimaa et al. (2017) Cities: Wolfram (2016), Garcia Ferrari et al. (2017), Fernandez Milan and Creutzig (2017)
Main Academic Audience	Transition scholars interested in the geography of experimentation and urban transitions	Transition scholars interested in urban experimentation and urban transitions	Transition scholars interested in urban transformative capacity and urban experimentation
Theoretical departure point	SNM and geography of transitions	Emerging literature on urban experimentation, including but not limited to SNM	Urban Transformative Capacity and Seedbeds-Harbours-Battlegrounds approach (outcome of paper 2)

Gaps/issues in Literature	Lack of a clear analytical approach to study the formation of favourable environments for experimentation, leading to inadequate treatment of the multiplicity of urban experimentation; place-specificity; co-existence of local and trans-local relationships.	Conceptual fragmentation and overemphasis on protection, with neglect of other generative dynamics for the formation of favourable environment.	UTC framework presently downplays the role of experimentation, premised on a narrow understanding of experiments
Paper's contributions	i. Development of a place-based approach to trace the development of favourable environments for experimentation ii. In-depth case study in Bristol, highlighting the effect of protection that emerges incidentally by the colocation of multiple initiatives, and the efforts of 'governing by leverage'	i. Development of the 'seedbeds-harbours-battlegrounds' approach to understand the formation of favourable environments for experimentation ii. Identification of various contextual dynamics and their implications to the uneven development of experiments and the emergence of place-specific styles of experimentation iii. Discussion of the implications for governance (considering ways to stimulate the formation of favourable environments for experimentation)	i. Demonstrates that experimentation play a wider role, contributing to different forms of learning and the development of multiple UTC factors iv. Suggests that what defines an activity as experimental is depend on its relationship with the context v. In-depth case study in Medellín, highlighting the experimental dimension of its transformation

Global contributions	• Advancing a contextual perspective on urban experimentation, including analytical strategy and analytical framework, that seeks to pluralise the debate on this area
	  ○ Delineates favourable environments for experimentation as object of study
	  ○ Highlights multiple contextual dynamics involved
	  ○ Creates opportunity to expand the scope of strategic niche management
	• Demonstrates non-linearity in how favourable environments form
	  ○ Attention to co-evolution with governance arrangements
	  ○ Possibility of mobilising experimentation to change governance itself
	• Critical reflection on how to 'move beyond experiments'
	• Input for the development of reflexive tools for practitioners involved in the initiation, evaluation and conduct of experiments or laboratories.		

Table 6.6 Summary of the aspects of the present understanding of urban experimentation which this thesis challenged, and of their analytical and governance implications.

Present emphasis of urban experimentation literature	**Perspective advanced in this thesis**	**Analytical implication**	**Governance implication**
Concern for the development of promising socio-technical trajectories (tracing the emergence of best practice)	Concern for the multiplicity of experiments in a particular place, the rationales which guide them, and the resulting reconfigurations	Need for ways of tracing genealogy of experimentation in particular places (see place-based approach in paper 1)	Shift in emphasis from deriving or reproducing 'best practice' to developing and mobilising favourable environment and transformative capacity
Protection as the primary dynamic enabling experimentation	Protection, connectivity and conflict as generative contextual dynamics enabling experimentation	Plurality of lenses may be useful to sensitise the analyses to relevant processes, identifying tensions and synergies (see seedbeds-harbours-battlegrounds)	Dynamics can be used reflexively, to consider avenues for improvement, or inquire on fit between intended experiments and context
Niches or laboratories as the primarily experimental loci, granting such protection.	Variety favourable environments can sustain experimentation, such as alternative milieu or the 'spaces of exception' created by crisis	Richer vocabulary needed to characterise the kinds of experimental settings, the dynamics which sustain them, and the politics which they imply	Efforts to establish designated experimental settings (e.g. laboratories) need to take into consideration prevalent contextual dynamics and political implications
Learning by doing with emphasis on second-order learning	Learning by doing, from elsewhere, and by taking into account, potentially contributing to second-loop learning	Differentiated approach to recording and making sense of learning in experimentation is needed.	Learning by doing is not a panacea. Differentiated approaches needed for intermediation and politics.
Experiments that have tight set of distinctive defining characteristics that make them experimental	Depending on the context, strategic projects, grassroots initiatives, and governance approaches can have outcomes analogous to experiments	Need to challenge growing conceptual fragmentation and over specificity of definitions of experimentation	Openness to various activities not labelled as experiments but which have a similar potential. Emphasis on facilitating learning in most processes.
Ability to experiment as a component of urban transformative capacity	Development of a favourable environment for experimentation as one avenue for generating and retaining multiple components of urban transformative capacity	Evaluation methodologies should pay more attention to capacity development as an outcome in evaluation methodologies. Other avenues are worth exploring.	Places with emerging favourable environments for experimentation may seek to valorise and boost their contribution to urban transformative capacity development

6.4 Implications for practice and for governance

The findings of this thesis suggest that engaging with favourable environments for experimentation may be a useful inroad for practitioners concerned with urban sustainability transitions. I would argue that many intermediaries, activists and government officials are already implicated in identifying proliferations of experiments, initiatives and projects, examining the dynamics involved in their formation, and working towards catalysing those dynamics. They may do so tacitly or using other theories. What this thesis contributes to those efforts is the possibility of reflecting about less intuitive dynamics, that try to get 'under the hood' of the current discourse of cities as laboratories for change.

As the second and third paper have shown, there are at least three sets of dynamics through which favourable environments for experimentation have been reported to emerge, primarily associated with forms of protection (seedbeds), connectivity (harbours), and conflict (battleground). This finding suggests that practitioners involved in urban experimentation may seek to i) identify what dynamics are most relevant in their setting, ii) intentionally develop activities to further develop the environment for experimentation, iii) invest in either the generation or retention of urban transformative capacity, as needed.

Based on these results, a fruitful area for engagement regards interventions operating at the level of the environment for experimentation. It does not suffice to initiate new experiments, or even laboratories, in settings which are already brimming with initiatives. This goes beyond an argument for more intermediaries, or more funding, and instead demands an actual diagnostic of the environment for experimentation (Table 6.4). It also goes beyond the established tools of strategic niche management, requiring a different and more expanded sensibility to other forms of interaction.

In a sense, this thesis demonstrates the importance of adopting a more discerned and intentional use of different aspects of urban experimentation. Sustained urban experimentation, as shown in the third paper, can contribute to developing

multiple aspects of urban transformative capacities, but is unlikely to have a lasting impact without the necessary efforts to support the retention of such capacities. Those involved in experimentation should ask themselves which forms of learning are most relevant in a particular place for a specific challenge and pursue activities most suited for that purpose. Using the three lenses presented earlier, it should be possible to identify the most promising avenues for such capacity development in a place, and identifying the most appropriate form of learning. For example, stimulating learning by doing through initiating socio-technical experiments is likely to benefit from efforts to develop a community of practice around that domain, and vice versa. However, it would be of little help for a context in which conflict is rife, where attempts at learning by taking into account would be more appropriate.

The urban transformative capacity and the seedbeds-harbours-battleground lenses developed here should help stakeholders diagnose their environments, and become more intentional in their attempts to initiate and catalyse experiments. Trial and error, in this sense, is only useful if it involves intentionality and reflection upon the results.

One way in which this could be operationalised, either by local governments or non-governmental organisations, would be by establishing organisations or teams capable of acting as 'observatories', concerned with monitoring, evaluating and seeking to connect across different experiments while also considering the overall direction of experiments. In hindsight, in both Bristol and Medellín organisations evolved organically to fulfil that role. In Bristol, CSE and at a later stage the Bristol Energy Network were able to both maintain an overview but also intervene strategically to support the development of the Energy Scene, while the local government activities promoting the city and drawing resources from the European Union contributed to developing that scene. Also, in both Bristol and Medellín, the robustness of public sector bodies and the emergence of strong collaborations with academia played a similar role, creating a body of academics and professionals which were highly committed and reflexive. Establishing such an observatory function, and developing the relationships that underpin them,

however, is not trivial, and took on decades of piecemeal investments and labour by many dedicated activists and public servants.

The case studies also raise the question of why particular sectors (e.g. energy or mobility) come to prominence amidst the discussions of sustainability in those cities. In Bristol, both mobility and energy have been central issues in the sustainability debates since the 1960s, in large part due to the contestation surrounding large scale projects (nearby nuclear power stations and massive highway infrastructures), which in turn provoked the emergence of social movement groups articulating alternatives (e.g. cycling and community-owned renewable energy sources). In Medellín, in contrast, the success of the municipal energy utility, its reliance on nearby hydropower capacity, and the massive investments it brings to the city meant that energy received much less attention as a point of contention. Meanwhile, the cities' topography and geographical location, and patterns of growth (upwards in the hills) meant that many of its troubles were tied in with mobility issues (e.g. violence in isolated communities, air pollution). As a result, mobility infrastructures has figured prominently as an object of experimentation, to the point that transformations in the city often pivoted around the development of mobility infrastructures and the possibilities of reconfiguring the relationships between different parts of the city.

One the one hand, this illustrates that the scope of sustainable urban experimentation cannot be assumed a priori; even though it is profoundly connected to the city's history and geography, it is also dependent on the ability of stakeholders to 'put these issues on the map' and mobilise the necessary resources to engage in urban experimentation. On the other, it also highlights that sustained urban experimentation in a particular domain and the transformative capacity it helps generate are crucial for establishing the centrality of a set of issues in governance and planning debates. In both places, the most ardent voices framing the challenges were also those implicated in seeking practical solutions via experimentation.

Hence, the two cases presented in this thesis suggest that developing a robust public conversation about the issues at hand is partly constituted through urban experimentation, and also appears to be a precondition for sustaining urban experimentation in a particular domain. Activists and public administrators alike have to be skilled in framing challenges, justifying their attempts to address them, and convening broader participation in the activities at hand. In this sense, they are indeed active in shaping the context for experimentation, and continually negotiating the conditions and legitimacy for their initiatives. Urban experimentation, in the sustained form studied in this thesis, creates opportunities for delineating disagreements, exploring multiple solutions at once, and facilitating discussions about the most fruitful courses for action. A favourable environment for experimentation is one that is underpinned by a constituency eager for change and capable to pursue it. Those outcomes, more than the success of specific experiments, is what raises the prospects of sustainable urban transformations.

The case in Bristol showed that efforts to leverage grassroots experiments to achieve strategic aims are always at risk of disenfranchising the very activists and community groups on which they depend. Relatively simple measures to involve those groups in establishing priorities and framing joint initiatives early on tend to foster commitment and facilitate the emergence of powerful synergies between grassroots and municipal teams. In particular, municipalities should aim at facilitating 'the percolation' between grassroots and municipal capacities, for example, by seconding staff, co-locating offices.

The case in Medellín illustrated how experimentation can have a mobilising effect, even in a context of crisis. Collective efforts to imagine and put to practice futures create spaces of hope, whilst also contributing to develop multiple aspects of the capacities necessary for navigating urban transformations. That hope, however, needs to be acted upon and concretised via other means, so a wider supportive institutional environment is crucial.

The research presented here could also be of use for transdisciplinary researchers. A promising avenue would involve organising collaborative research projects and participatory workshops to map the ecology of experiments in particular cities and inquire about what dynamics may be sustaining or hindering experimentation and its embeddedness. Such an examination could be part of current efforts to promote transitions management or as a preliminary stage in the development of laboratories. Developing experiments aiming to scaling them up is not the only avenue for system change. In the future, I hope to continue developing these ideas into more actionable approaches, to support practitioners explore different pathways for change.

6.5 Future avenues for research

Aside from the avenues for research noted in three papers, I can see four areas for future research with which I hope to engage others.

First, to continue the conceptual and practical tools to analyse and support urban sustainability transitions in their plurality. Research in this domain could do more to explore and differentiate the pathways[9] through which urban transition processes are thought to unfold, noticing the different patterns and contextual situations which enable then. Transitions studies became more plural when studies started to unpick and discern between a multiplicity of pathways, rather than taking technological disruptions through niche-breakthroughs as the implicit model for change (Geels and Schot, 2007; Smith et al., 2005). A similar movement is necessary for urban sustainability transitions. In a sense, the formation of a favourable environment for experimentation within cities and accumulation of transformative capacities may be one such path. To some extent, the literature has already begun examining other pathways and explored their specific and problematic political consequences, for example, through the gradual reconfiguration existing socio-technical systems (Bulkeley et al., 2014b; Hodson et al., 2017), the development of new cities or districts (Caprotti, 2014; Cugurullo,

[9] In the sense of patterns through which change unfolds, rather than particular directionalities.

2018), or the rescaling of wider socio-technical systems (Späth and Rohracher, 2010). There is also a growing recognition of the multiple processes of embedding through which experiments come to have systemic impact (Turnheim et al., 2018a). Nevertheless, much emphasis is still on how to embed and scale experiments into existing systems and mainstream institutions (a politics of insertion). However, there is no systematic presentation of what these different paths are, nor engagement with modes of systemic change that are discussed among urbanists. I hope that STRN's new thematic group in urban transitions and transformations can provide the space to develop such understanding.

Second, to further the understanding about the specific forms of intermediation and support for learning that can be used to prop up favourable environments for experimentation and the development of transformative capacity. What forms of 'connective tissue' emerge between the multiple diffuse experiments that occur in such settings, which 'provides glue' to these initiatives? How are different forms of learning made persistent? Transitions studies have dealt with it primarily with the notion of 'cosmopolitan' or 'global' level niche formation, which does not address the multiplicity of experiments co-located in a particular place. The lenses identified in the second paper, and expanded on the third, provide a first approximation to that question.

Further research on the strategies of intermediaries and on the political consequences of those strategies is critical. For the harbour lens, the policy mobilities literature is an obvious complement (Hannam et al., 2006; McCann, 2013, 2017; Sheller and Urry, 2006; Temenos and McCann, 2012). For the battleground lens, closer engagements with social movement theories could be fruitful. Particularly, the notion of 'social skill' may be useful to highlight the ability actors develop to analyse contested social situations and induce cooperation among others (Fligstein, 2001, 2008; Fligstein and McAdam, 2011, 2012). However, as with experimentation, research should avoid the trap of trying to define a singular, overarching theory for what constitutes such connective tissue is, and focus instead on the various processes which may be of relevance,

Third, examining how urban experimentation, futuring and co-design can be combined in meaningful ways to open up new pathways to sustainability. Transition management has led the way in thinking iteratively about these techniques (Frantzeskaki and Loorbach, 2010b; Nevens et al., 2013; Nevens and Roorda, 2014), and about the (proactive) role of researchers can take in these issues (Wittmayer et al., 2014; Wittmayer and Loorbach, 2016). What other combinations of these practices can help mobilise support towards sustainability transitions? Future research should consider whether there are ways of combing futuring and experimentation that go beyond the search for consensual long-term visions and reliance of protection? I hope to take on this research forward in my upcoming post-doctoral research.

Finally, and relatedly, future research should aim to develop a robust comparative research programme, preferably drawing from cosmopolitan and post-colonial perspectives of comparative urbanism (Mcfarlane, 2010; Robinson, 2002, 2004, 2005, 2011, 2016; Ward, 2010), and engagement with similar concerns emerging in the STRN (Hansen et al., 2018). As Clarke (2012) summarises,

> the point [of such approach to comparison] is not to categorise, label, and rank such cities – as global and megacities, or modern and traditional cities, or developed and underdeveloped cities. Neither is to create urban hierarchies within which the policies of cities at the top get imitated by those of lower rank. Rather, the point is to provincialize European and North American cities because the majority of the world's population no longer lives in "the West." It is also to recognize diverse cities with diverse histories; cities that coincide with distinctive territories or places; and diverse urban experiences and ways of being urban. Ultimately, the aim is to expand imaginations of city life and the practices of urban development.
>
> (Clarke, 2012)

In particular, it is important to reflect on how would urban transitions research change if it adopted a more cosmopolitan approach and engaged with a more diverse set of cities and theories emerging from other places (Robinson, 2002). Transition scholars should be particularly careful not to assume that cities in the global north are 'referent cities' and assume a priori that these cities have better

governance and organisational capacities to bring about systemic change. This entails comparison both as a *strategy of critique* for examining theoretical and empirical claims and as a *strategy of alterity* to instigate new lines of inquiry and situated accounts (Mcfarlane, 2010).

Most of transitions research are based in European institutions and funded through European funding streams or national programmes (including a large number of Australian cases). There is a risk that urban transitions research reaffirms a European notion of (sustainable) urbanism as universally desirable, or which serves to advance the interests of trans-national interests engaged in promoting universal visions, such as with smart urbanism. Here, useful first steps may be engaging with notions of post-networked urbanism, that question the presumed convergence of socio-technical systems towards northerly infrastructural templates (Coutard and Rutherford, 2016; Rutherford and Coutard, 2010), and engaging with 'actually existing comparative urbanism' by tracing the interurban partnerships that cross the north-south divide (Clarke, 2012).

6.6 Final words

It is an exciting and daunting period for transitions scholars. Our knowledge is at once in demand and forsaken. The stakes of ongoing system change are high. It is tempting to assert what we have learned, to promote it loudly and in doing so shut down the reminiscent doubt amongst ourselves. Profound (socio-environment, socio-technical, socio-economic) changes are urgent, widespread, and global.

So, it is easy to portray the local as petty, the slow as innocuous, the reflection as frivolous. It is tempting to suggest that rolling out what we know already is necessary, and thus rush into the most scalable solutions, to replicate the beneficial, to settle the inconsequential and carry on with what is urgent.

But those changes will be with us for generations, and the urgency will not go away. Profound changes are the new normal. We must resist that temptation if we are to avoid reproducing the worst excesses of the politics of change which brought us here.

Experimentation is no longer a luxury, nor a strange creature, but a flourishing space for action. We ought to learn about learning in this way, to sustain it and harness it in all its forms. We ought to make of it a new politics of change, not postulated in blueprints, nor inferred by big data, but on the messy and complicated politics that emerges in learning by doing, learning from elsewhere, and learning by taking-into-account. We need to find ways to change places in ways that matter to people.

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8 APPENDICES

Appendix A. List of interviewees – Bristol

All but one of the interviewees agreed to be named in the research.

Table 8.1 Interviewees in Bristol

Name	**Roles**
Anonymous	Community energy practitioner and researcher
Bridget Newbery	Community Project Manager, CSE; Volunteers, BEN
Caroline Bird	Research Fellow, University of Bristol; Chair BEN
David Saunders	Founder, Bristol Power Co-op
Lorna Edwards	Former Community Energy Project Manager, BCC, Energy Services Team
Lorraine Hudson	Smart Cities and Sustainability Consultant; Former Climate Change Co-ordinator
Mark Leach	Project Manager BCC, Sustainable City Team; Former Green Capital Coordinator
Martin Fodor	Councillor, BCC; Former Sustainable City Policy Co-ordinator
Peter Thompson	Chair, Bristol Energy Co-operative
Simon Roberts	Chief Executive, CSE; Board Member BEN.

Appendix B. Details of the search procedure

The figure below represents the procedure we followed for our research. We began the effort to identify a suitable corpus for analysis with a search on the Scopus database, by combining searches for different terms referring to experimentation, and a search regarding terms associated with sustainability and climate change. Each time, we focused on the title, abstract and keywords of documents (TITLE-ABS-KEY command). The search command W/3 (within three words) was used to ensure that variations and permutations of the search terms were found, such as urban sustainability experiment or urban climate change experiments. The combined search string also limited results to English documents only and excluded conference papers (see Box 8.1).

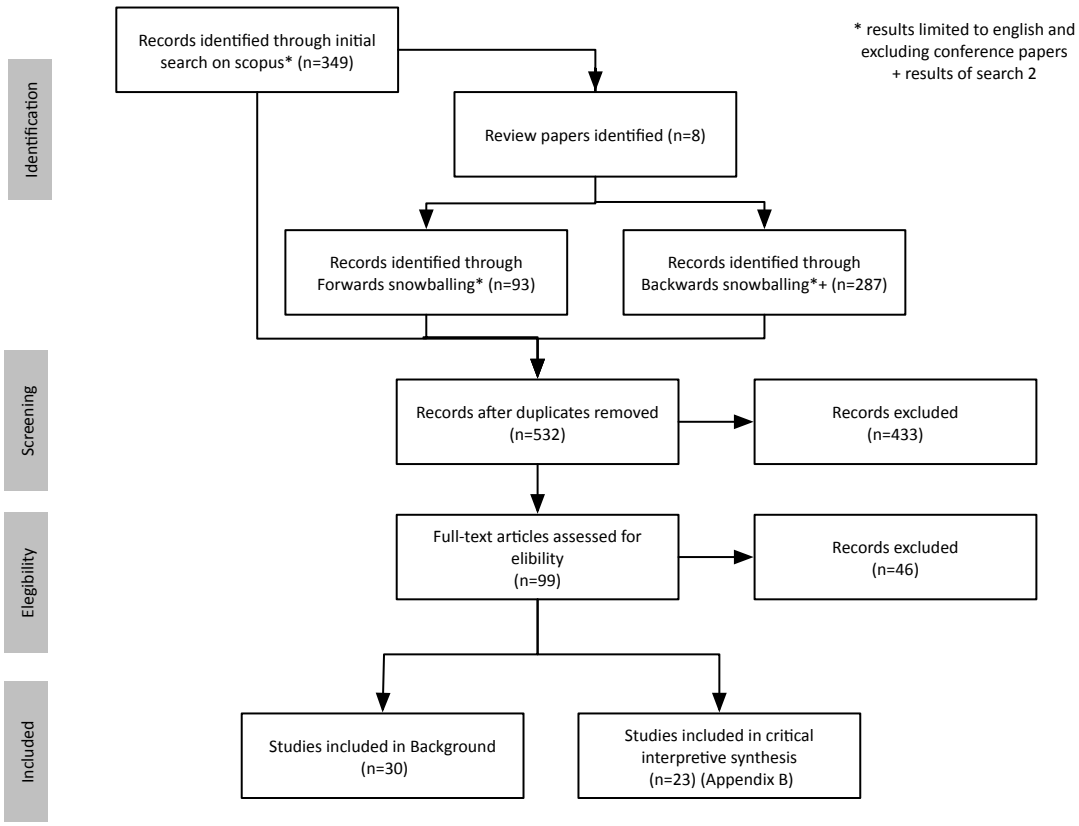

Figure 8.1 Search procedure

```
TITLE-ABS-KEY (((urban* OR local* OR socio-technical OR
sociotechnical OR niche* OR govern* OR grassroot*) W/3
(experiment*)) AND (sustainability OR "sustainable
development" OR "climate change")) AND (LIMIT-
TO(LANGUAGE,"English")) AND (EXCLUDE(DOCTYPE,"cp"))
```

* Scopus' wildcard for 'any number of characters'

Box 8.1 Search string used in Scopus for the initial search.

The bibliographical information of these results was exported to MS Excel®, where a table was created to handle the results. We then examined the abstracts and identified 8 relevant literature reviews.

On the second and third stage, we proceeded with a search of all the articles citing those reviews (forward snowballing), and all the articles cited by those reviews (backwards snowballing). For the backwards search, we refined the results by searching for terms related to experimentation (string on Box 8.2). The results were added to the same table and the duplicates removed (using the MS Excel® function). When possible, missing abstracts were completed with the help of extra searches.

```
TITLE-ABS-KEY(nich* OR experiment* OR lab OR labs OR
laborator*)
```

* Scopus' wildcard for 'any number of characters'

Box 8.2 Search string used to refine results of the backward snowballing

Screening of the abstracts led us to disregard entries which were not associated with our topic. We excluded, for example, irrelevant entries focused on experiments used primarily as a method of enquiry in environmental and sustainability sciences, and geography (e.g. fieldwork). After the screening, 99 records were considered for a second triage. Initially, we read the introduction of the and conclusions of the articles, selecting those studies which foregrounded the relationship between the urban context and experimentation. Regarding articles dealing with niche construction, for example, we included studies that made clear questions of embeddedness, the influence of place-specific factors, and institutional settings, but excluded studies focusing primarily on niche-regime interactions that were not specific to the urban context. This led to 23 studies

concerning the development of favourable environments for experimentation (included in the CIS, see Appendix C) and 30 articles which informed the background.

Appendix C. Papers reviewed

The tables below summarise the key points, theoretical underpinning (aside interest in experimentation) and methodologies of the papers considered in each of the groupings (Table 8.2-8.4). In a few instances, we included references to works which were not included in the initial searches, but which illustrated the lenses very clearly (

Table 8.5).

Table 8.2 Grouping of papers which informed the seedbed lens

Reference	Main concern	Theoretical underpinning	Method	Overlaps with another lens
Coenen et al. (2010)	Argues proximity advantages could help explain local niche experimentation	SNM Geography of innovation (proximity)	Case study of aquifer thermal storage in the Netherlands	Harbour
Holm (2011)	How experiments in sustainable housing in Denmark became situated transition arenas and what role did municipalities play	SNM	Four cases of situated niches of eco-construction in Denmark	
Schereuer et al. (2010)	Issues arising when embedding experiments in cities	Constructive Technology Assessment, SNM	Case study in fuel-cell technology in the city of Graz	
van den Heiligenberg et al. (2010)	Assessment of the success factors for experimentation, and typology of habitats for experimentation	Transition Management, SNM, Regional Innovation Systems	Survey of 56 experiments in Europe.	
Wolfram (2018)	Role cities play in emergence and formation of grassroots niches	SNM, grassroots innovations, urban social innovations	Case study of Seoul efforts to support grassroots initiatives	

Table 8.3 Grouping of papers which informed the harbour lens

Reference	Main concern	Theoretical underpinning	Method	Overlaps with another lens
Blok (2014)	Suggests an alternative vocabulary and method with which to study and compare eco-housing experiments	Assemblage Urbanism, Worlding Cities, Cosmopolitics	Multi-site ethnography of eco-housing experiments in Kyoto, Copenhagen and Surat	
Blok, Tschötschel (2016)	Argues that Asian and European world port cities are forming a	Cosmopolitan risk communities	Survey of experiments in 16 world port cities and analysis of experiment databases	
Longhurst (2015)	Highlights the role of alternative milieu in creating socio-cognitive protection for sustainability experiments	Geography of sustainability transitions; Territorial innovation models	In-depth case study of alternative milieu in Totnes	Seedbeds
Sengers and Raven (2015)	Development of a spatial perspective on niche-formation	Geography of sustainability transitions Buss-Pipelines Global Production Networks Policy mobilities	Case-study of BRT systems in multiple Thailand cities considering web data, interviews and ethnographic work	Seedbeds
Silver (2017)	How global actors are increasingly involved in local-carbon restructuring, using places at the margins to experiment and dominate governing, sparking contestation	Urban Political Economy	Case-study of waste-management experiment in Mbale, Uganda	Battlegrounds
Wieczoerck et al. (2017)	Development of a typology for transnational linkages	Geography of sustainability transitions	Analysis of 200 solar PV projects in India	Harbours

Table 8.4 Grouping of papers which informed the battleground lens

Reference	Main concern	Theoretical underpinning	Method	Overlaps with another lens
Bulkeley et al (2014)	Proposes a typology to examine how justice is articulated, practiced and contested in climate change experiments	Climate justice Climate Change Experiments	5 case-studies of experiments in Bangalore, Monterrey, Hong Kong, Philadelphia and Berlin	
Fuchs and Hinderer (2014)	New approach to analyse emergent forms of governance brought about by local energy initiatives	Strategic Action Fields	Comparative Case-studies in 4 German regions	
Gopakumar (2014)	Emergence of public-private partnerships as laboratories for marketisation of water supply	Science and Technology Studies Political Ecology	Case study of a water-supply partnership in Bengaluru (India)	
Håkansson (2012)	How do grassroots initiatives take shape in particular contexts	Place making Gentrification	Ethnographic case study in Peckan (South London, UK).	Seedbeds
Jørgenses (2012)	Proposes Arenas of Development as an alternative understanding of	Arenas of Development Actor-Network Theory Sense Making	Three illustrative cases including city resistance to highway development in Copenhagen	
Mclean et al. (2016)	Explore the use and consequences of UE in restructuring governance and opening up new spaces for private investment	Climate Change Experiments	In-depth case study of a smart energy grid project in Austin, Texas	Seedbeds

Table 8.5 Relevant empirical studies included in the analysis, that were not found in the searches but were cited by works in the corpus

Reference	Main concern	Theoretical underpinning	Method	Associated lens
Condehet (2010)	Understanding how a creative milieu emerges	Creative Cities	Two Case studies in the city of Montreal	Seedbeds
Torrens et al. (2018)	Unpacking the formation of a favourable environment for experimentation with civic energy alternatives	SNM, Contextual reconfiguration	In-depth case study in Bristol	Seedbeds, Harbours
Amin et al. (2002)	Understanding the uneven distribution of the social economy	Relational urban geography	Four case studies in UK cities concentrating multiple initiatives in social economy	Harbours
Carvalho et al. (2012)	Understanding the mobility of green urban transport policies	Economic geography and innovation studies	Case studies in Curitiba, Göteborg and Hamburg	Harbours
Blanchet (2015)	Why do grassroots initiatives emerge around energy distribution in cities, and how do they influence the governance of urban energy systems?	Strategic Action Fields Grassroots Innovations	Case study of conflicts around ownership of Berlin's electric grid	Battlegrounds
Murphy (2015)	Explores the promise of human geography to complement transition studies	Relational placemaking	Illustrative case study of conflicts surrounding smart growth initiatives in Boston Metropolitan Regions	Battlegrounds

Appendix D. Criteria for signposting UTC components

To identify the relevant components UTC, we adapted a simplified version of framework proposed by Wolfram (2016). The level of detail in each components reflects the state of the literature, rather than the relative importance of these factors. At the exception of experimentation (for which the three lenses approach was used), those components were signposted in the case narrative, according to the criteria suggested by Castán Broto et al. (2018). In the table below, we present these together, using the original labels proposed by Wolfram (2016).

Table 8.6 Criteria for signposting components of urban transformative capacity

Component/ capacity development factor (from Wolfram, 2016)	**Signposted when evidence found for… (from Castán Broto et al., 2018)**
C1 Inclusive multiform urban governance	
C1.1 Participation and inclusiveness	Active participation of citizens and/or civil society organisations in process of planning and decision making
C1.2 Diverse governance modes and network forms	Different and various stakeholders working together and building connections between sectors in different manners
C1.3 Sustained intermediaries and hybridisation	An intermediary positioned between the various stakeholders of a project
C2 Transformative leadership (in public, private and civil society actors)	Leadership acting as a driving collaborative force in an initiative
C3 Empowered communities of practice	
C3.1 Addressing social needs and motives	Either analysing or addressing social needs
C3.2 Community empowerment and autonomy	Integrating into the design of the project different aspects of community empowerment
C4 System(s) awareness and memory	
C4.1 Baseline analysis and system(s) awareness	Agendas aiming to tackle sustainability challenges after deliberate analysis of urban systems
C4.2 Recognition of path dependencies	Explicitly tackling systemic barriers to change
C5 Urban sustainability foresight	
C5.1 Diversity and transdisciplinary co-production of knowledge	Involvement of various and multiple stakeholders in knowledge production processes
C5.2 Collective vision for radical sustainability changes	An explicit future vision shared among stakeholders are a means for motivating partners and fostering commitments

C5.3 Alternative scenarios and future pathways	Comparative scenarios that evaluate the mutual shaping of social, ecological, economic and technological dimensions
C6 Diverse community-based experimentation with disruptive solutions	*Deliberate use of experiments or ideas that seek to challenge the existing landscape of established policies, technologies or social practices*
C7 Innovation embedding and coupling	
C7.1 Access to resources for capacity development	Project stakeholders sharing resources for capacity development outside the project to disseminate and multiply results
C7.2 Planning and mainstreaming transformative action	Attempts to generalise the project operation or results beyond the initial context of application
C7.3 Reflexive and supportive governance frameworks	New regulation was established as a result of the project or as part of the project initiatives
C8 Reflexivity and social learning	Stakeholders reflecting on learning and capacity building processes
C9 Working across human agency levels	Project activities contributing to capacity development across human agency levels
C10 Working across political-administrative levels and geographical scales	Project activities contributing to building capacity across geographical or political-administrative levels

Appendix E. List of Interviewees - Medellín

All interviewees agreed to be named in this research.

Table 8.7 Interviewees in Medellín

Interviewee	**Relevant positions**
Alejandro Echeverri	Director of URBAM, EAFIT University; Former EDU Director; Former Planning Director, Municipality of Medellín
Alexander Jiménez Laverte	Planning department, Metro de Medellín
Carlos Cadena Gaitan	Professor in URBAM; Co-founder and volunteer at Ciudad Verde
Daniel Carvalho Mejía	Councillor, Medellín City Council
Françoise Coupé	Professor of Planning Universidad Nacional de Colombia, Director of the Planning Council
Jorge Perez Jaramillo	Architect and Planning, Former Director of Planning, Former Sub-Director of AMVA, Former Dean Universidad Bolivariana
Juan Álvaro Gonzales Vélez	Coordinator 'gestion social', Metro de Medellín
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